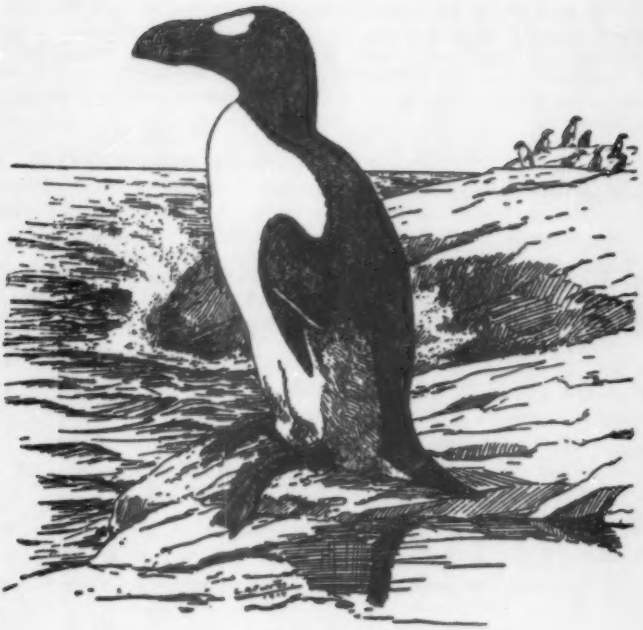
The Auk

A Quarterly Journal of Ornithology

Vol. 77 JANUARY, 1960 No. 1



PUBLISHED BY

The American Ornithologists' Union

CONTENTS

FAT-FREE WEIGHTS OF BIRDS. *Clyde E. Connell, Eugene P. Odum, and Herbert Kale* 1

ON THE TEMPORAL PATTERN OF NOCTURNAL MIGRATION IN THRUSHES. *D. A. Vleugel* 10

SECONDARY ARTICULATION OF THE AVIAN MANDIBLE. *Walter J. Bock* 19

PROCEEDINGS OF THE SEVENTY-SEVENTH STATED MEETING OF THE AMERICAN ORNITHOLOGISTS' UNION. *H. G. Deignan, Secretary* 56

TREASURER'S REPORT FOR THE PERIOD AUGUST 1, 1958–JULY 31, 1959 69

REPORT TO THE AMERICAN ORNITHOLOGISTS' UNION BY THE COMMITTEE ON BIRD PROTECTION, 1959 73

REPORT OF THE RESEARCH COMMITTEE FOR 1959 78

GENERAL NOTES

Bachman's Sparrow Hiding in a Burrow. *James A. Pittman, Jr.* 80

Mutation in an African Flycatcher, *Dyaphorophyia concreta*. *Melvin A. Traylor* ... 80

First Specimens of Sooty Shearwater for Delaware. *Peter W. Post* 82

Semipalmated Sandpiper and Western Sandpiper in Tamaulipas. *George Miksch Sutton* 83

Color of the Tarsi and Toes of the Black Rail. *Brooke Meanley and Robert E. Stewart* 83

The Basis of Color Dilution in an Albinistic Blue Jay. *John Whitaker* 84

Egg Replacement by a House Wren: Incubation Period. *Hervey Brackbill* 85

Communal Courtship in the Ruffed Grouse, *Bonasa umbellus* L. *David A. Adams* 86

Errors Concerning the Date and Source of the Name *Melanotrochilus* Eudes-Deslongchamps (Trochilidae). *Robert M. Mengel* 87

The Skeleton and Systematic Position of *Gampsonyx*. *Pierce Brodkorb* 88

The Duration of Postnuptial Metabolic Refractoriness in the White-crowned Sparrow. *James R. King, Richard Mewaldt, and Donald S. Farner* 89

Nesting of Louisiana Waterthrush and White-throated Sparrow in Eastern Coastal Massachusetts. *Henry S. Forbes and Jane D. O'Regan* 92

A Substitute Name for *Crypturellus strigulosus peruvianus*. *Emmet R. Blake* 92

Thick-billed Kingbird Nesting in New Mexico. *Dale A. Zimmerman*..... 92

The Migratory Status of Some Western Desert Birds. *Gordon W. Gullion* 94

REVIEWS 96

RECENT LITERATURE. Edited by *Frank McKinney* 101

NOTES AND NEWS 115

OBITUARIES 117

Printed by The Intelligencer Printing Company
Lancaster, Pa.

Entered as second-class matter in the Post Office at Lancaster, Pa., May 15, 1920, under the Act of August 24, 1912

Accepted for mailing at special rate of postage provided for in the Act of October 3, 1917, embodied in paragraph (d)-(2) of Section 34.40, P. L. and R., of 1948, authorized May 15, 1920.

THE AUK

A QUARTERLY JOURNAL OF

ORNITHOLOGY

VOL. 77 JANUARY, 1960 No. 1

FAT-FREE WEIGHTS OF BIRDS*

CLYDE E. CONNELL, EUGENE P. ODUM, AND HERBERT KALE

OUR extensive studies of lipid deposition in birds (Odum and Perkinson, 1951; Odum and Connell, 1956; Odum, 1958, 1959) have shown that the fat-free weight, in marked contrast to the total live weight, is remarkably constant for a given species and sex. A migrating male Red-eyed Vireo *(Vireo olivaceus)*, for example, may weigh from 16 to 28 grams, while the weight of the body minus the fat will vary but a gram or so from 15. The fat-free weight of birds of the same wing length is even more constant, regardless of the total live weight of the individuals.

Actually there are two "fat-free" weights to be considered. The *nonfat dry weight, lean dry weight,* or simply *lean weight* is the weight of the bird minus both the fat and the water. The *fat-free* weight, on the other hand, is the weight of the bird minus only the fat. Since there are small variations in water content, and also since dehydration of specimens may occur before fat extractions are made, the lean dry weight generally exhibits a somewhat smaller coefficient of variation than the fat-free weight. Consequently, the lean dry weight is better suited for analyses of basic differences due to age, sex, season, or any other factor. However, the fat-free weight is of greater interest to the bird bander or other investigator working with the living bird. As will be demonstrated in this paper, one can accurately calculate the amount of fat simply by subtracting the known fat-free weight from the total live weight of the individual.

Knowledge of fat-free weight is also important for other reasons. Serious errors of interpretation can result when certain rates or ratios are expressed in terms of the total weight in cases where fat content is subject to wide variations. Metabolic rate, mineral content, or uptake

* This study is a byproduct of ecological research supported by an AEC grant [contract AT (07-2)-10].

of radioactive isotopes are best considered in terms of the fat-free or lean weights. King (1958) has recently pointed out that opposite conclusions regarding metabolic rates could be drawn depending on the weight basis used. In the example cited, fat birds had a lower metabolic rate per gram total weight but a higher rate per gram fat-free weight than thin birds.

In this paper we shall first analyse in detail the fat-free weight of a single species, the Savannah Sparrow, and then present a table of average fat-free and lean weights of other species of migratory birds. Conclusions relating to the fat-free weight apply equally well to the lean dry weight.

FAT-FREE WEIGHT OF THE SAVANNAH SPARROW *(Passerculus sandwichensis)*

In connection with studies on the Savannah Sparrow as a component of the "old-field ecosystem" (Norris and Hight, 1957; Odum and Hight, 1957), a total of 230 specimens have been extracted. Some of these were killed by striking television towers at Aiken, South Carolina, and Tallahassee, Florida, during fall migrations, while others were collected with mist nets at various times from October to May on the old fields of the Atomic Energy Commission Savannah River Plant area in Aiken and Barnwell counties, South Carolina. All specimens were carefully weighed, sexed, aged (in so far as possible by skull ossification), and then racially determined by Dr. Robert A. Norris (see Norris and Hight, 1957). Birds were kept frozen until extracted according to the following procedures (see Odum, 1959, for additional details): The bird was completely dehydrated in a vacuum oven and the total dry weight determined; the difference between the dry weight and the original fresh weight represented the water content. The dry residue was then extracted by two fat solvents (alcohol and ether) and a final weight, the lean dry weight, determined. The fat-free weight was obtained by adding the weight of the water to the lean dry weight, and the value checked by subtracting the fat weight from the original wet weight. Let us now consider briefly various factors which might affect the fat-free weight.

Sex. The fat-free weight of males averaged significantly greater than that of females (see Table 2), but not when individuals of the same wing length were compared. For example, males with wings 68-69 mm. did not differ in weight statistically from females having the same wing lengths. In other words, males average heavier than females because they average larger in body size.

Age. When adults and immatures of the same sex and wing lengths were compared no significant differences in the fat-free weight were found. Twenty-two adults and 22 immatures with wings of 70-71 differed only 0.23 ± 0.25, while 20 adults and 22 immatures with wings of 68-69 differed only 0.07 ± 0.30.

Fat. When fat and thin birds of the same wing length and season were compared no significant differences in fat-free weight were found. Sixteen birds with wings 70-71 and a fat index less than 8 per cent (fat 8 per cent total live weight) differed only 0.03 ± 0.34 from 23 birds with the same wing measurements but with a fat index greater than 8 per cent. Likewise, fat and thin birds of wings 68-69 differed only 0.13 ± 0.37.

Race. There were small differences in the average fat-free weights of the four races which winter commonly in the southeastern United States:

P.s. savanna (a large, light-colored race)	16.16 gms.	(111 individuals)
P.s. labradorius (a large, dark race)	16.27 gms.	(48 individuals)
P.s. mediogriseus (a medium-sized, light race)	15.38 gms.	(53 individuals)
P.s. oblitus (a small, dark race)	15.01 gms.	(16 individuals)

Two individuals of the rare *P.s. nevadensis* (a small, light race) averaged 14.92 grams. When birds of different races but having the same wing length were compared, no significant differences were found. It was evident that racial differences in weight are the result of differences in average body size.

Season. When individuals of same wing length taken in fall, winter, and spring were compared, it was found that the fat-free weight in fall was significantly lower than in the winter and spring. The magnitude of this difference is shown in Figure 1. Analysis of variance showed that the estimated variance between wing-length categories and also between fall and winter or spring was significantly greater than would be expected were samples from the same population. Weights in winter and spring did not differ significantly. While winter and spring birds were generally fatter than fall birds, fat as such apparently did not explain this difference (as indicated in the above paragraph). Perhaps carbohydrate or other nonfat reserves are depleted to a small extent in postmigratory birds. A portion of the fall sample was from television-tower kill, but there was no difference in fat-free weight between such birds and birds taken by mist nets in the old fields in October and November.

Wing length. As would be expected over-all body size as indicated by the wing length proved to be the most important factor influencing the fat-free weight. In fact, as indicated by the above analyses, no other factor except season need be considered; and seasonal differences

Figure 1A.

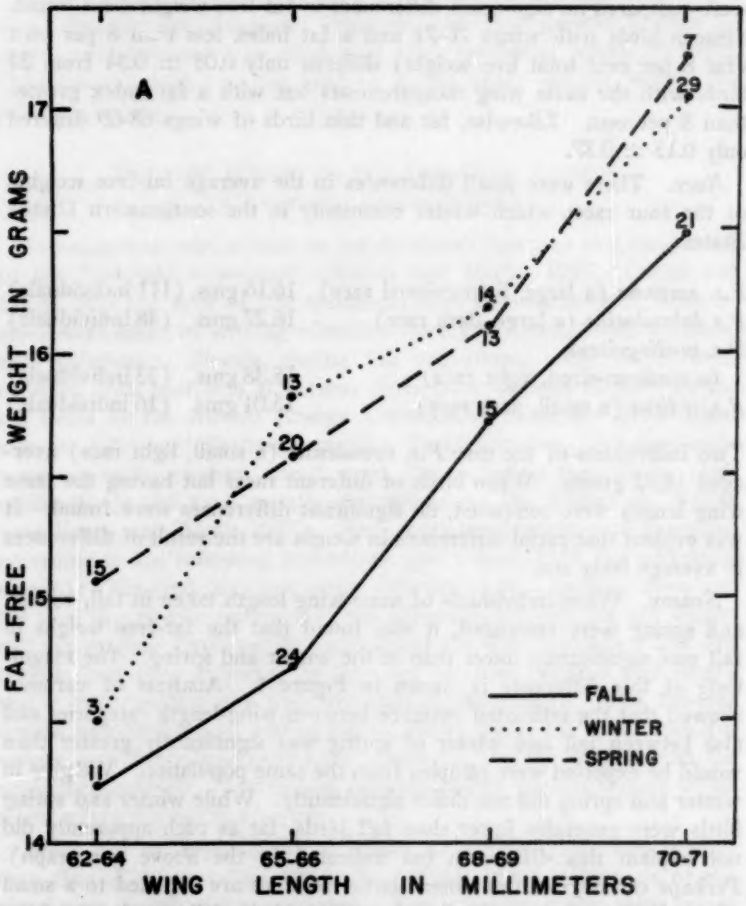


Figure 1. Fat-free weights of Savannah Sparrows in relation to wing length by seasons (upper graph, A) and for all 230 individuals on a semilog plot (lower graph, B). Numbers on curves in the upper graph are number of individuals.

TABLE 1

FAT-FREE WEIGHTS OF SAVANNAH SPARROWS (*Passerculus sandwichensis*) OF DIFFERENT WING LENGTHS

Wing length mm.	*Number of birds*	*Fat-free wt. in gms.*	
		Actual values	*Estimated from graph*[1]
63	8	14.58	14.50
64	18	14.88	14.80
65	29	15.12	15.10
66	28	15.42	15.40
67	23	15.75	15.70
68	24	16.17	16.00
69	18	15.76	16.30
70	36	16.85	16.60
71	21	16.86	17.00
72	13	17.59	17.40

[1] Figure 1, lower curve.

are hardly great enough to be of concern to the bird bander. Accordingly, fat-free weights as function of wing lengths are plotted in Figure 1, both for seasons separately and for all of the 230 specimens together. The relationship appears curvilinear on the arithmetic plot and approaches a straight line in the semilog plot. In Table 1 average fat-free weights for each wing length are shown, together with values estimated from the smoothed curve (lower graph, Figure 1). Since the fat-free weight is a more precise measurement than the wing length, use of the figures from the smoothed curve are fully justified. The figures in the last column of Table 1 are best used in calculating the fat content of a living Savannah Sparrow. In general, the fat-free weight increases 0.30 grams for each mm. of wing length in small- and medium-sized birds, and 0.40 grams per mm. in large birds.

Figure 1B.

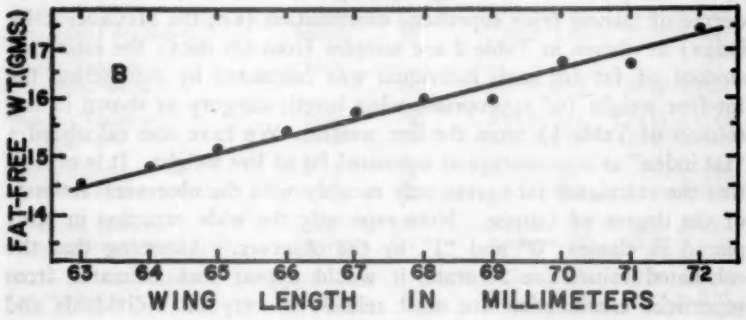


TABLE 2

CALCULATION OF BODY FAT CONTENT OF LIVING SAVANNAH SPARROWS *(Passerculus sandwichensis)* BANDED AND RELEASED

Bander's observation[1]				*Calculation of fat*		
Date (1958)	*Wing mm.*	*Live weight gms.*	*Fat class*[2]	*Fat-free wt.*[3] *gms.*	*Gms. fat*[4]	*Fat index*[5] *%*
Sept. 9	63	16.9	0	14.5	2.4	14.2
Sept. 21	64	16.1	0	14.8	1.3	8.1
Oct. 4	67	20.3	0	15.7	4.6	22.7
Oct. 4	68	17.5	0	16.0	1.5	8.8
Sept. 20	66	17.7	1	15.4	2.3	13.0
Oct. 14	71	21.3	1	17.0	4.3	20.2
Feb. 17	65	17.0	1	15.4	1.6	9.4
Feb. 17	70	17.2	1	16.6	0.6	3.5
Sept. 20	64	19.4	2	14.8	4.6	23.7
Feb. 17	67	20.0	2	15.7	4.3	21.5
Feb. 17	65	20.0	3	15.1	4.9	24.5
Feb. 21	69	23.5	3	16.3	7.2	30.6
Feb. 21	70	20.5	3	16.6	3.9	19.0
Feb. 21	70	24.0	3	16.6	7.4	30.8
Feb. 21	69	21.9	4	17.0	4.9	22.4
Feb. 21	70	23.6	4	16.6	7.0	29.7

[1] Dr. James Baird, Norman Bird Sanctuary, Middletown, Rhode Island.
[2] Fat condition as judged by external appearance (the McCabe index).
[3] From last column in Table 1.
[4] Live weight minus fat-free weight.
[5] Live weight/gms. fat × 100.

CALCULATING THE AMOUNT OF FAT IN THE LIVING BIRD

Table 2 illustrates how the bird bander or experimental ornithologist could calculate the amount of fat in the living bird from the data on fat-free weight. Dr. James Baird has kindly sent us some data on Savannah Sparrows from his banding station in Rhode Island to use as an example. The live weights, wing measurements, and estimate of degree of fatness from superficial examination (*i.e.*, the McCabe, 1943, index) as shown in Table 2 are samples from his data; the estimated amount of fat for each individual was calculated by subtracting the fat-free weight (of appropriate wing length category as shown in last column of Table 1) from the live weight. We have also calculated a "fat index" as a percentage of estimated fat of live weight. It is evident that the calculated fat agrees only roughly with the observers' estimate of the degree of fatness. Note especially the wide variation in birds placed in classes "0" and "1" by the observer. Assuming that the calculated values are accurate, it would appear that estimates from superficial examination are most reliable in very fat individuals and

least reliable in the low and intermediate ranges where considerable amount of internal fat may not be visible.

FAT-FREE WEIGHTS OF OTHER MIGRATORY SPECIES

In Table 3 the fat-free and also lean dry weights are given for a number of migratory species. These data are based on television-tower-killed specimens, except for a portion of the Savannah Sparrows which, as already indicated, were taken with mist nets. The weight-wing

TABLE 3

AVERAGE FAT-FREE WEIGHTS AND STANDARD ERRORS OF THE MEAN OF 14 SPECIES OF MIGRATORY BIRDS

Species	*Sex*	*Number individuals*	*Nonfat dry or lean wt. in gms.*	*Fat-free wt. in gms.*
Sora Rail *Porzana carolina*	female	7	17.08 ± 0.34	49.83 ± 0.42
Ruby-throated Hummingbird *Archilochus colubris*	male female	9 12	0.64 ± 0.014 0.71 ± 0.017	2.50 ± 0.11 2.76 ± 0.10
Swainson's Thrush *Hylocichla ustulata*	female	10	7.31 ± 0.12	26.22 ± 0.30
Red-eyed Vireo *Vireo olivaceus*	male female	87 91	4.74 ± 0.034 4.66 ± 0.032	15.05 ± 0.11 14.55 ± 0.12
Tennessee Warbler *Vermivora peregrina*	both	11	2.41 ± 0.063	7.94 ± 0.13
Magnolia Warbler *Dendroica magnolia*	both	8	2.37 ± 0.17	6.70 ± 0.40
Black-throated Blue Warbler *Dendroica caerulescens*	both	16	2.30 ± 0.084	7.64 ± 0.17
Bay-breasted Warbler *Dendroica castanea*	both	10	3.50 ± 0.11	9.88 ± 0.27
Bobolink *Dolichonyx oryzivorus*	male female	10 16	8.60 ± 0.10 7.66 ± 0.18	25.04 ± 0.98 22.92 ± 0.47
Scarlet Tanager *Piranga olivacea*	both	28	8.18 ± 0.10	23.52 ± 0.24
Summer Tanager *Piranga rubra*	male female	19 25	8.47 ± 0.11 8.05 ± 0.10	24.13 ± 0.40 23.87 ± 0.21
Indigo Bunting *Passerina cyanea*	male female	37 18	4.20 ± 0.05 3.97 ± 0.04	13.14 ± 0.18 12.46 ± 0.11
Savannah Sparrow *Passerculus sandwichensis*	male female	108 122	5.13 ± 0.021 4.63 ± 0.020	16.65 ± 0.07 15.27 ± 0.06
White-throated Sparrow *Zonotrichia albicollis*	male female	9 35	7.49 ± 0.024 6.92 ± 0.006	22.75 ± 0.14 21.24 ± 0.05

length relationship could, of course, be worked out for those species where large numbers of individuals have been extracted, but this refinement is not yet possible in many cases. Since the average fat-free weight of males and females differs in many species, separation by sexes is sufficient for most purposes. In species listed in Table 3 males generally average larger and heavier than females; female hummingbirds, however, are significantly heavier than males (see also Norris, Connell, and Johnston, 1957). The sexes were not separated in species where the number and/or weight differences were small. Additional material may, of course, show that a sex difference does exist in these species.

In summary, these data (Table 3) may be used to determine the approximate fat content of living or freshly collected birds, bearing in mind the following: (1) The fat content of individuals larger than average will be overestimated (since fat-free weight will be larger than average) and that of small individuals underestimated. If the wing measurement is taken at the time of banding or handling, a correction could easily be worked out based on trends shown in Figure 1 and Table 1. (2) Since most individuals on which Table 3 is based were taken during the fall migration the values may be slightly lower than at other seasons, assuming that the relationship with season demonstrated in the Savannah Sparrow also holds for other migratory species. (3) The data presumably are applicable to any individual which has completed its postjuvenal molt.

It should be emphasized that all the fat-free weights discussed in this paper refer to healthy birds. Starved or diseased birds may not only lose practically all of their fat, but their total weight could be less than the fat-free weight as given in Tables 2 and 3. If the fat-free weight drops more than a gram or so below the "normal" (as sometimes has happened in our captive birds), the bird rarely recovers; apparently too much of the vital "body" has been consumed. So far, all of the hundreds of television-tower-killed birds we have processed have appeared healthy with a minimum of 2 per cent and a maximum of about 50 per cent fat.

SUMMARY

The fat-free weight, and also the lean dry weight, is relatively constant for birds of the same size (as indicated by wing length) and species in marked contrast to the total live weight which, in migratory species, fluctuates greatly because of the large variations in fat deposits. Accordingly, the amount of body fat of the living bird, or fresh speci-

men, may be accurately calculated by subtracting the fat-free weight (as a previously determined constant) from the live weight. Detailed analysis of fat-free weights of 230 Savannah Sparrows showed that sex, age, and racial differences were entirely the result of differences in basic body size as indicated by wing length. Postmigratory individuals, however, exhibited a lower fat-free weight than wintering or premigratory individuals of the same size. Fat-free weight values for males and females would provide the bird bander with a basis for a reasonably good estimate of the fat level. For a more precise estimate, fat-free weights would need to be worked out for each wing-length category, or else corrections made for individuals larger or smaller than average for the species. A table of fat-free and lean dry weights of 14 species of migratory birds is included.

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ON THE TEMPORAL PATTERN OF NOCTURNAL MIGRATION IN THRUSHES

D. A. VLEUGEL

ONE of the singular paradoxes in investigations of nocturnal migration in America has been the apparently contradictory results between studies based on observations of migrants silhouetted against the face of the moon (Lowery, 1951) and the studies of Ball (1952) by counting flight calls of migrating thrushes. Lowery and Newman (1955: 238, 258–262) discuss this discrepancy, noting that reports of numerous moon watchers scattered over North America indicated that normally nocturnal migration shows a pattern of an increasing number of migrants in the period before midnight, with a single peak in the hour before midnight, a sharp drop thereafter, and usually little evidence of migratory movement in the predawn hours (Lowery, pp. 414–417; Lowery and Newman, pp. 258–260). Ball's work, based upon counting of flight calls by thrushes over a period of 12 years in autumn in the Gaspé, eastern Canada, indicates the opposite. Ball recorded by far the greatest number of calls in the predawn hours after midnight. Though Ball noted a minor period of activity in the early evening before 10 P.M., the second (very much greater) peak occurred during the hour or so before dawn, and with practically no activity about midnight. Ball's work convinced him that some migrating thrushes, after resting, arise an hour or two before dawn and proceed some distance before being grounded by daylight.

To explain these discrepancies, Lowery and Newman (pp. 258–262) made various suggestions, based chiefly upon the differing techniques of the two methods; but they admit that their efforts to reconcile the results seem inadequate. The most obvious explanation, that calls can only be heard when birds are rising or descending and not when they are flying high (for Ball estimated that 1,500 feet was about as far in vertical distance as the calls could be distinguished), was discounted by Ball, who tried to test this possibility by listening about midnight at higher elevations. But still he heard no flight calls.

The present paper compares with those of Ball the results of flight-call counting and other techniques used in Europe. In general they give support to the conclusions of Lowery and Newman based upon counting silhouettes of birds as they cross the face of the moon. Some suggestions are made for the reinterpretation of Ball's data, based upon the local situation in the Gaspé.

THE EUROPEAN DATA

During the autumn of 1950, I (1954) made flight-call counts of those migrant species which, in Holland, can be most easily heard at night. These nocturnal migrants included several species of thrushes *(Turdus)*. In 1950, I made observations each night between 8:00 and 10:00. One or more additional one-hour observations were made at other times of the night and also after sunrise. The highest frequency of sounds generally occurred before midnight. In 23 hours of observation before midnight (the evenings with bad weather are left out), an average of 10 call notes per hour was heard. In 35 hours of observation after midnight, the average was six call notes per hour. I continued the observations in 1951, 1952, and 1953, but they have not been worked out in detail. However, no material change in the distribution pattern of thrush calls was noted. If anything, in 1951 there appeared to be a smaller proportion of thrushes migrating after midnight than in 1950.

During four exceptional nights (out of 17) in 1950 there were more call notes between 4:00 A.M. and 6:00 A.M. than between midnight and 4:00 A.M. The predawn increase in these four nights was from 4 to 20, 1 to 48, 8 to 40, and from 4 to 8 call notes per hour. Such predawn activity was found to occur when one or more of the following conditions were present: (a) before or during passage of a cold front; (b) after unfavorable weather conditions, with the weather improving during the latter part of the night; (c) after a drop in temperature (frost), with the drop in temperature greater in the predawn hours.

All European observers have found the nocturnal pattern of migration similar to that which I have observed. Siivonen (1936) in Finland made observations on call notes of migrating thrushes *(Turdus)* in autumn. He noted that the number of call notes increased until about 10:00 P.M. After that the rate declined in general, reaching zero at about 1:00 A.M. He made no observations during the remainder of the night, although he showed with a recording apparatus *(l.c.)* that there was a second peak from 4:00–6:00 early in the morning. He showed further that in captive birds there was a clear increase of *Zugunruhe* (migratory restlessness) about that time. I (1954) found, as mentioned above, the same increase in some cases. Possibly this predawn increase in *Zugunruhe* is rather general and applies to actually migrating birds. Perhaps they leave their roosts after a period of rest only when this second peak in *Zugunruhe* reaches a high value. Siivonen and I found that this increase in some cases even lasted until some hours after daybreak.

Palmgren (1949) in Finland noted the same fluctuation of *Zugunruhe* with a similar apparatus (the actograph) as Siivonen. He states (p. 571): "The activity graphs of the nocturnal restlessness of night-migrating insectivorous birds (*i.e.*, Song Thrush, *Turdus philomelos*), agree very closely in form with the rhythm of night migration as observed in nature. The activity starts, as a rule, after a short period of sleep (½–2 hours), culminates before midnight and fades out gradually." Palmgren gives graphs of the nocturnal restlessness of two Song Thrushes in autumn. Both of them showed more or less restlessness until 3 A.M., but far more before midnight. At about 4 A.M., a new short period of restlessness began. Palmgren *(l.c.)* says on this second period: "In some individual birds the outburst of restlessness occurs in the last hours of the night."

P. W. P. Browne (1953) also observed and counted the call notes of migrating thrushes in autumn at night near Dublin in Ireland. He does not mention in this paper his hours of observation, but in a letter to me he wrote: "Most of the listening was carried out at times when calls were coming at a maximum rate (about 22:00–23:00 G.M.T.)." It is unfortunate that he did not observe further on in the night.

Sutter (1957), near Zürich, Switzerland, found with radar that as a rule there seemed to be more migration before midnight than after it in autumn. However, in one case (out of eight) there was more migration after midnight than before.

According to Spencer (1952), Darlington came to similar conclusions in England. He says: "Graphs show intense passage after dark reaching a peak and then rapidly declining, with little movement in the early hours of the morning. Probably renewal of activity shortly before dawn is indicated in Darlington's paper." W. G. Harper (1959) points out that recent radar studies in Britain confirm the conclusions of Lowery as to the maximum time of nocturnal migration.

Possible Reinterpretation of Ball's Data

Summary of Ball's observations. Ball (1952) recorded thrushes by their call notes in autumn from 1940–1951, but he observed continuously only in the seasons of 1947–1950. His main observations were made on the narrow, southeasterly projecting Forillon at the tip of the Gaspé Peninsula, Canada, south of the St. Lawrence River. The thrushes he observed were the Olive-backed (Swainson's) Thrush *(Hylocichla ustulata swainsoni)*, the Hermit Thrush *(H. guttata faxoni)*, and Bicknell's (Gray-cheeked) Thrush *(H. m. minima)*.

Except for one large evening flight (at Maria on the south coast of

Gaspé Peninsula) of 450 birds, fully 90 per cent of the calls of migrant thrushes were recorded in the hour before dawn. In fact, Ball recorded 32,700 thrush calls after midnight, but only 1,221 calls before 10 P.M.—a ratio of 27 to 1. That migrant thrushes were seldom heard by him between 11:00 P.M. and 3:30 A.M. was confirmed during more than 50 observation periods of two to three hours in 12 seasons at Gaspé. Since thrushes were noted in four cases during the night, he inferred that the great dawn flights of vocal migrants comprised not large flocks of birds that had flown all night from some distant source but rather an accumulation of small groups that had arisen, perhaps after midnight, from various areas within the river system. This conclusion was supported by the greater numbers heard in the lower parts of the valleys.

Ball also states generally that the same nocturnal pattern of thrush migration was noted by him in New England (Connecticut). As he does not give any specific observations, no analysis is possible.

An interpretation of Ball's data based on the local geography. It is curious enough that so few thrushes were heard migrating in the evening on the Gaspé Peninsula. Moreover, why were there so many flight calls in the early morning?

1. Throughout his study, Ball expressed the view that his migrating thrushes were chiefly the local breeding birds of the Gaspé Peninsula. However, he says (p. 191): "it is believed that in autumn some birds reach Gaspé from Anticosti (visible across 40 miles of water)." In his opinion the thrushes that breed north of the St. Lawrence River normally follow the north shore and as a rule do not cross it to the Gaspé. They should cross it more to the west, where the river is narrower.

This seems contrary to what has been found in Europe. Wider stretches of the North Sea, for instance, are crossed very often (*e.g., Turdus pilaris,* Schaanning, 1948; *Turdus merula,* Holgersen, 1953). On two occasions I saw Blackbirds *(Turdus merula)* going off across the North Sea at The Hague at about sunset. In April 1958, many Blackbirds and also other thrushes which came from over the sea were heard on the beach there.

Ball's conclusions are supported by the following observations (p. 191): "both evening and dawn movements are mainly radial in valleys, and numbers greater at lower ends; numbers smaller in tributary valleys that lack good passes at their heads; no faint call-notes high above the ground, few above 300 feet; none above the tops, not only of the highest Shickshock mountains (4,000 feet), but even over mountains of moderate height; preliminary studies reveal no high-level migrants

crossing the moon's face; local population is much greater than required to account for the number of migrants."

However, none of these observations is really conclusive. The only observations which would reveal the truth would be observations near the coasts of the St. Lawrence itself, and these have not been made so far.

2. Ball's chief observation place was Sandy Beach. This spot is on the south shore of Gaspé Bay, which here appears to be seven miles broad. In my opinion (based upon observations on the coast of the North Sea), there are not many migrating thrushes to be expected in such a locality in the evening, for the following reasons:

(a) Thrushes that have to cross a broad stretch of water like the St. Lawrence are likely to start at about sunset. When they have arrived at the coast of Gaspé Peninsula, they will as a rule not immediately proceed much farther inland, because the mountains are a barrier to an easy passage. They are likely to rest after crossing the St. Lawrence.

(b) When the weather is good and there is no change in wind direction (Vleugel, 1954), thrushes will try to proceed farther inland. This second start is begun in general some hours before sunrise (see Siivonen, 1936; Palmgren, 1949; and Vleugel, 1954). However, on most occasions the thrushes will not start again that same night. They are more likely to continue farther south by day, as I have often seen. This has been observed in the United States, too (Dennis and Whittles, 1955; 1956). Bagg (1957: 325) reports also daytime movements of nocturnal migrants (warblers) during the spring of 1957. The thrushes that have landed north of Sandy Beach need only fly 8 to 10 miles to reach Gaspé Bay. As the urge to migrate is lowest during the "second night-migration" and the flight by day, few thrushes will make a second overwater flight to cross Gaspé Bay. Instead, they will proceed along the north shore of Gaspé Bay and will not be heard or seen at Sandy Beach. It is thus understandable that during the evening and early night there are hardly any thrushes migrating over Sandy Beach. For similar reasons in the spring I do not usually hear thrushes on the Dutch coast before about 10:30 P.M. This can be explained by assuming that they need three hours or more to cross the North Sea, which is about 200 kilometers broad here. Presumably the same reason applies at Sandy Beach: one cannot hear the call notes of the thrushes before they have arrived.

My opinion is supported by Ball's own observations. On p. 86 he notes that on 20 September 1949, he made observations at Maria on the coast of Chaleur Bay. The wind was from the east (5 m.p.h.). He

says: "Along this shore and on the fields 450 thrushes passed during the period, 7:35–9 P.M." This observation suggests that many birds must have collected there previously on or near the south coast of Gaspé Peninsula.

My conclusion is that Ball, as a rule, missed the first flight of thrushes that crossed the St. Lawrence in the premidnight hours. He generally counted only the "second flight" in the last hours before sunrise, and this he could only do when the weather was so good that the birds continued on to cross Gaspé Bay. As can be seen from his Table 3 (p. 92), there were only a few nights during which a good number of migrating thrushes were counted: in 1947, Aug. 18–Sept. 30 (44 days) only 7 nights; in 1948, Aug. 16–Sept. 30 (46 days) only 8 nights; in 1949, Aug. 19–Sept. 30 (43 days) only 15 nights; in 1950, Aug. 21–Sept. 30 (41 days) only 16 nights.

This can be explained if we assume that thrushes cross a broad stretch of water like the St. Lawrence only in good weather. Ball's weather data (p. 92) indicate that thrushes were noted only with light air or slight breeze. Out of 46 days with good or rather good flight-call counts in four years (1947–1950), there were only three days when the wind strength exceeded 5 m.p.h. We cannot wish a better indication that the thrushes Ball counted at before dawn on the Forillon probably crossed the St. Lawrence in the evening and then crossed the Gaspé mountains after a rest during the night. We know from the literature that also in Europe mountains are crossed in the early morning by night migrants (summary in Lack and Lack, 1953).

There is another possible reason, in my opinion, why the number of early morning call notes noted by Ball might be too high in comparison with those in the hours before midnight. Thrushes are early risers, and local birds habitually call and fly about at dawn. In addition, in autumn they have social roosts from which they fly in movements that may be confused with migration. In my paper (1954), I omitted thrush calls during the last hour before sunrise because I found it impossible to say which sounds were coming from actually migrating thrushes and which sounds were made by local thrushes flying around or leaving their roosts.

According to Ball's Table 1 (p. 55), 90 per cent of his call notes of thrushes during five mornings were recorded *in the last half hour before dawn*. To avoid confusion with local birds, I have found it necessary to omit call notes the first hour before sunrise and after sunset, except when the birds are unequivocally observed migrating. (Whether the period disregarded should be half an hour or a whole hour is uncertain; perhaps a period of three quarters of an hour would suffice. I have

recorded call notes of many resident thrushes for half an hour after sunset and some 10 minutes longer.) This may not be a major source of difference in Ball's data and mine, but it is a factor that should be considered.

Graber and Cochran (1959) have recently recorded automatically, with a device using a parabolic reflector, the calls of migrants in Illinois on 125 nights. They conclude (pp. 229–233) that at least some species migrate throughout the night and report that often a marked increase in the number of calls was recorded during the predawn hours. However, they believe that this does not indicate an increase in the number of migrants, but probably reflects only an increase in the frequency of calling. This was sustained by observations made during the autumn of captive *Hylocichla* thrushes (the group which provided Ball with his major data); these thrushes called most in the predawn period. As a further partial explanation of Ball's results, Graber and Cochran (p. 233) suggest, though this was discounted by Ball (1952: 57) and Lowery (1951: 419), that birds may possibly fly higher during the middle hours of the night, and thus be out of hearing.

Acknowledgments

I should like to thank Mr. Eugene Eisenmann and Professor Donald S. Farner for correcting my English and for some helpful suggestions and also Dr. George H. Lowery who drew my attention to the divergent results of the late Dr. Ball and helped me in several respects.

Summary

Studies in America based on observations of migrant birds silhouetted against the face of the moon suggest that the peak of nocturnal migration usually occurs during the hours before midnight. On the other hand, a 12-year study by Ball using the technique of counting thrush flight calls in autumn on the Gaspé Peninsula, eastern Canada, indicated to him that the peak of migration was in the early morning hours.

Flight-call counting of migrant thrushes in Holland by the writer, and elsewhere in Europe by others, indicates that (except under unusual weather conditions) many more flight calls are noted in the hours before midnight than in the hours before dawn. Studies in Europe of *Zugunruhe* (migratory restlessness) in captive birds and published radar data appear to confirm the view that in Europe the peak of nocturnal migratory activity generally comes before midnight, with a lesser peak before dawn. Perhaps many migrating birds rest during

the postmidnight hours, sometimes resuming migration in the predawn period.

A possible reinterpretation of Ball's data, based mainly on the location of his observation area, is suggested: 1. Ball's main site on the Gaspé Peninsula was not only south of the wide St. Lawrence River, but on a southeastern projection south of Gaspé Bay. Birds migrating across the St. Lawrence before midnight would not be heard by him unless they also crossed Gaspé Bay, and this second crossing would occur the same night only with favorable winds, and presumably in the predawn hours after the birds had rested. Usually they probably avoid crossing Gaspé Bay by coasting along it by day. 2. In his counts Ball included calls heard in the first half hour before dawn; these probably included calls of local thrushes leaving roosts or flying around. Furthermore, it is possible that a tendency of *Hylocichla* thrushes to call more during the predawn period may have contributed to his results.

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SECONDARY ARTICULATION OF THE AVIAN MANDIBLE

WALTER J. BOCK

Introduction

The avian skull, and especially its jaw apparatus, has always been a favorite subject for students of evolutionary and functional anatomy. Any analysis of this delicate and complicated "machine" requires an extensive knowledge of mechanics as well as of morphology; indeed, the resources of the most competent anatomist are taxed whenever he undertakes a functional study of the avian skull. Omission of even a single feature from analysis usually means that the entire study must be redone. Such is the problem with functional investigations of the avian mandible. Anatomists have always assumed that the quadrate-articular hinge is the only suspension of the mandible, and the working hypothesis used in previous studies on the mechanics of the jaw apparatus has been that the forces which counteract the disarticulating forces on the mandible must be supplied by the quadrate hinge. The jaw muscles and ligaments attaching to the mandible provide, of course, some support for it, but for the sake of simplicity these nonbony elements will be omitted from discussion. However, the quadrate is not the only support of the mandible. In many groups of birds, a secondary bony support of the mandible—*the medial brace of the mandible*—lies medial to the quadrate-articular hinge. This brace is formed by the medial process of the mandible abutting against the base of the skull, the hinge between the two bones being *the basitemporal articulation of the mandible*. The functional consequences of this secondary brace are obvious. For many anatomists, information about this brace will be comparable to telling an engineer that there is a third support in the middle of a bridge after he has determined the bridge stresses by assuming that the only supports were at the ends.

The discovery of the medial brace was quite by accident during a taxonomic review of the plovers. Among other features of the skull, I had to examine a process on the lateral margin of the basitemporal plate (Bock, 1958: 46). Much to my surprise, this process was capped by a pad of tissue which was fibrous in nature. At the time, I was preoccupied with the comparisons and did not realize the significance of this capping pad. Several days later during a lull in the taxonomic investigations, I returned to the problem of why this process of the basitemporal plate should have a fibrous capping pad. Only then did I realize that fibrous pads on bony processes mean, in general, only one thing—another bone articulates on this process. But the only bone

which could possibly abut on the lateral basitemporal process is the medial process of the mandible. If the mandible articulated on the basitemporal plate, the plovers would have two separate suspensions of the lower jaw—a condition unknown in all other recent tetrapods and one that is of extreme importance to studies on the evolution of the mammalian jaw articulation. With this and the functional consequences of a second mandibular brace in mind, the taxonomic comparisons were forgotten, and skulls with the lower jaw in place were examined. The medial brace was discovered in the first specimen. My first thought was that surely someone had described this brace earlier. But a search through the literature and correspondence with other ornithologists and anatomists were fruitless; no one knew of any mention of a secondary brace of the avian mandible in the literature. However, although the medial brace was unknown to recent workers, including myself, it had already been described many years ago by Shufeldt (1890a: 354; 1890b: 71; 1893: 339) in the gulls, terns, and skimmer, even though he did not name it or attach any functional importance to it. For some inexplicable reason, little attention was paid to Shufeldt's discovery by his contemporaries—indeed, I do not know of a single reference to it in the literature. Consequently today the medial brace is a completely unknown structure. It may seem strange that the medial brace has escaped the attention of every avian anatomist except Shufeldt. But it is rather obscure in most forms in which it is found, and no one suspected a need for an additional brace of the mandible and hence did not look for one.

Examination of the skull of other avian families revealed that the medial brace is present in many diverse groups of birds in numerous degrees of specialization, and this discovery led to an extensive study of this structure. Therefore, I shall present in this paper a description of the medial brace and the basitemporal articulation, a discussion of its functional significance, and the results of a survey of its occurrence in birds. A discussion of its evolution and of its significance in understanding the evolution of the mammalian jaw articulation as well as some points of general evolutionary theory has been presented elsewhere (Bock, 1959). It was also necessary to study in detail two other features of the skull—the quadrate hinge and the processes of the basicranium—both of which are closely associated with the development of the medial brace. These will be discussed along with the survey of the brace.

THE MEDIAL BRACE OF THE MANDIBLE

Description of a species lacking the medial brace. The jaw articulation of the Boat-tailed Grackle (*Cassidix mexicanus,* Icteridae), a species having only the quadrate-articular suspension of the mandible, is described first to establish a standard against which the medial brace and the basitemporal articulation can be compared.

The three articular condyles of the quadrate are shown on the right side only in Figure 1. The medial condyle is the largest and provides the greatest amount of support for the lower jaw as is indicated by the well-developed articular surface —a deep cavity—on the mandible for this condyle. The medium-sized lateral and the small posterior condyles are continuous with one another and are separated from the medial condyle by a shallow groove; the posterior condyle appears merely as a narrow ridgelike extension of the lateral condyle. The corresponding articular surfaces on the mandible for these condyles are continuous with one another and form a shallow groove that faces medially. The articular condyles of the quadrate form a rough horseshoe, which bounds a cavity lying between the lateral and medial condyles. A knob of bone on the mandible fits into this cavity. This arrangement of the articular surfaces of the mandible embracing the condyles of the quadrate serves to prevent sidewards or backwards displacement of the mandible. The lateral process of the basitemporal plate abuts against the body of the quadrate and serves as a brace to prevent the quadrate from being displaced medially or posterially. This brace of the quadrate is found in many passerine

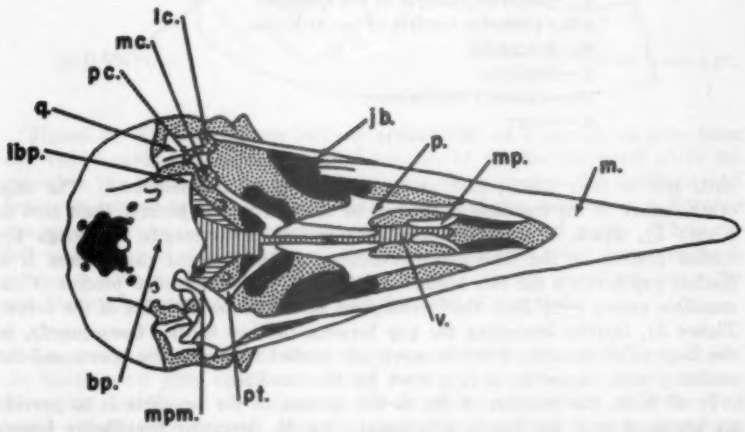

Figure 1. Ventral view of the skull of a grackle. The posterior end of the right ramus of the mandible was removed to expose the condyles of the quadrate. These are cross-hatched. On the left side of the skull, the medial process of the mandible approaches the basitemporal plate but does not touch it. The deep-lying bones are shaded for contrast. The key to the abbreviations used in all figures can be found on p. 22.

KEY TO ABBREVIATIONS USED IN THE FIGURES

ac.—articular cavity
ap.—articular pad
ba.—basitemporal articulation
bc.—basicranium
bp.—basitemporal plate
bsa.—basisphenoid articulation
cf.—collagenous fibers
cp.—capping pad on the lateral basitemporal process
ep.—exoccipital process
jb.—jugal bar
lbp.—lateral basitemporal process
lc.—lateral condyle of the quadrate
lca.—lateral condyle of the articular
m.—mandible
mbp.—medial basitemporal process
mc.—medial condyle of the quadrate
mca.—medial condyle of the articular
M. d. m.—M. depressor mandibulae
mp.—maxillo-palatine
M. pt.—M. pterygoideus
mpm.—medial process of the mandible
oc.—occipital condyle
opq.—orbital process of the quadrate
p.—palatine
pc.—posterior condyle of the quadrate
pca.—posterior condyle of the articular
pt.—pterygoid
q.—quadrate
sm.—synovial membrane
v.—vomer

birds and in some others, such as the goatsuckers (Caprimulgidae). The only other feature of the mandible of interest to us is its medial process (best seen in Figure 2), which is relatively narrow in respect to its length. Although the medial process of the mandible approaches the basitemporal plate, there is a distinct gap between the two bones. As the bill opens, the medial process of the mandible moves away from the basitemporal plate (in the direction of the arrow, Figure 2), thereby increasing the gap between the two bones. Consequently, in the Boat-tailed Grackle, there is never any contact between these bones, and the medial process cannot serve as a brace for the mandible.

In all birds, the function of the medial process of the mandible is to provide an increased area for muscle attachment; the M. depressor mandibulae inserts along the posterior rim of the medial process, and the M. pterygoideus attaches to its anterior surfaces. The length and shape of the medial process is then, at least, roughly correlated with the strength of either one or both of these muscles. However, because of its close proximity to the base of the skull, the medial process is preadapted to provide additional support for the mandible should the need for this support arise. With a slight increase in length and a change in

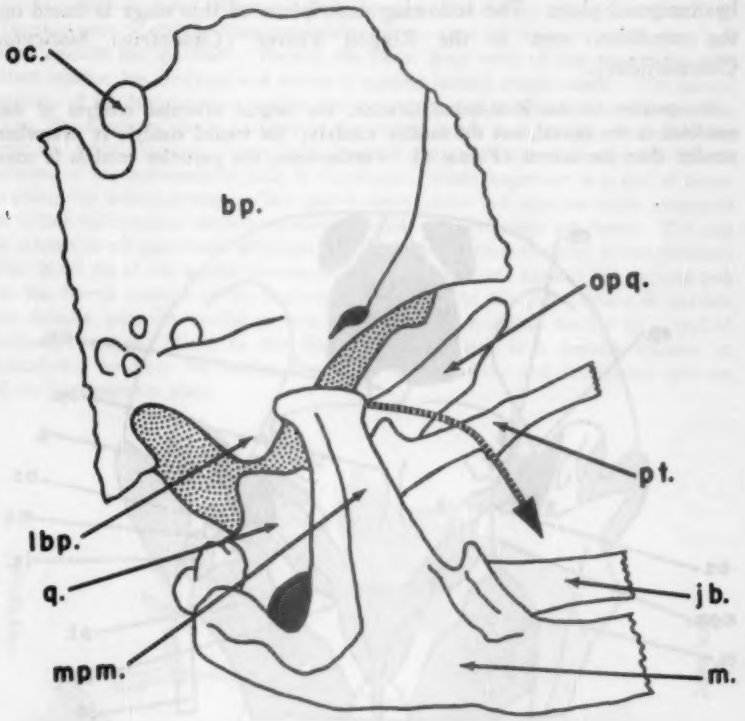

Figure 2. Close-up of the left-jaw articulation of a grackle as seen from the ventro-medial side. The lateral process of the basitemporal plate approaches the quadrate; in life this process abuts against the quadrate and braces it against inward displacement. A distinct gap may be seen between the medial process of the mandible and the basitemporal plate. When the bill opens, the medial process of the mandible moves away from the basitemporal plate in the direction of the arrow. Hence there can never be any contact between the mandible and the base of the skull.

shape, mainly a broadening of the process, the medial process would abut against the basitemporal plate and thereby brace the mandible. Once the two bones are in contact, some type of articulation (a functional requirement whenever two bones rub upon one another) would have to develop—perhaps, at first, some form of simple articulation, which could evolve into a true diarthrosis with increased demand on the newly arisen brace.

The medial brace in the plovers. The first step in the development of the medial brace and the basitemporal articulation is the establishment of a contact between the medial process of the mandible and the

basitemporal plate. The following description of this stage is based on the condition seen in the Ringed Plover (*Charadrius hiaticula*, Charadriidae).

In contrast to the Boat-tailed Grackle, the largest articular condyle of the quadrate is the lateral, not the medial, condyle; the medial condyle is somewhat smaller than the lateral (Figure 3). Furthermore, the posterior condyle is con-

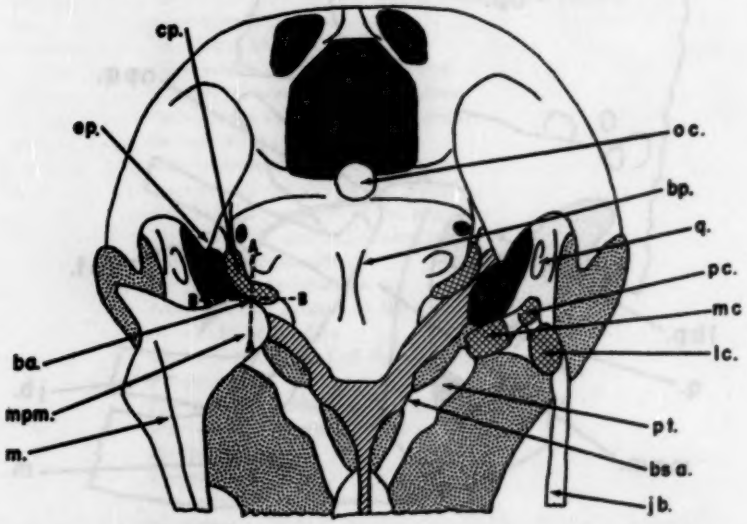

Figure 3. Skull of a Ringed Plover seen from the postero-ventral side. The right ramus of the mandible was removed to expose the condyles of the quadrate. Both the quadrate condyles and the capping pads on the lateral processes of the basitemporal plate are cross-hatched. The medial process of the mandible articulates against the capping pad as shown on the left side of the skull. Lines "A-A" and "B-B" indicate the plane of sectioning for the histological slides. Again, the deep-lying bones are shaded for contrast.

tinuous with both the medial and the lateral condyles, not only with the lateral. The quadrate condyles are arranged in the usual horseshoe pattern, but they are more rounded than in the Boat-tailed Grackle with the result that the cavity between the lateral and medial condyles is poorly defined. The articular surfaces on the mandible are relatively flat and lack the knob that fits into the cavity between the lateral and medial condyles of the quadrate. Hence in the Ringed Plover, the articular surfaces of the quadrate-articular hinge do not offer as much protection against possible disarticulation of the mandible when the bill is opened. Again in contrast to the Boat-tailed Grackle, the medial process

of the mandible in the plover is broad; in fact, it is almost as wide as it is long. Turning now to the basitemporal plate, we see that its lateral process does not abut against the quadrate. Rather, the outer bony wall of the eustachian tube abuts against the quadrate and braces it against inward displacement. The lateral process of the basitemporal plate is more posterior and medial than in the grackle. Also, the quadrate slants forward in the plover, while it is almost vertical in the grackle, which accounts for a large part of the gap between it and the lateral process of the basitemporal plate in the plover. More important is a pad of tissue capping the lateral process. This pad is tan in color and appears to be composed of either collagenous fibers or fibrocartilage; it is definitely not bone. The pad is present in all specimens, although it is often lost during cleaning of the skeleton. The distal tip of the medial process of the mandible abuts against the capping pad on the lateral process of the basitemporal plate. At the point where it touches the capping pad, the medial process is smooth and rounded, similar to a typical articular surface. Thus, in the Ringed Plover, there is a definite contact or articulation between the medial process of the mandible and the lateral process of the basitemporal plate.

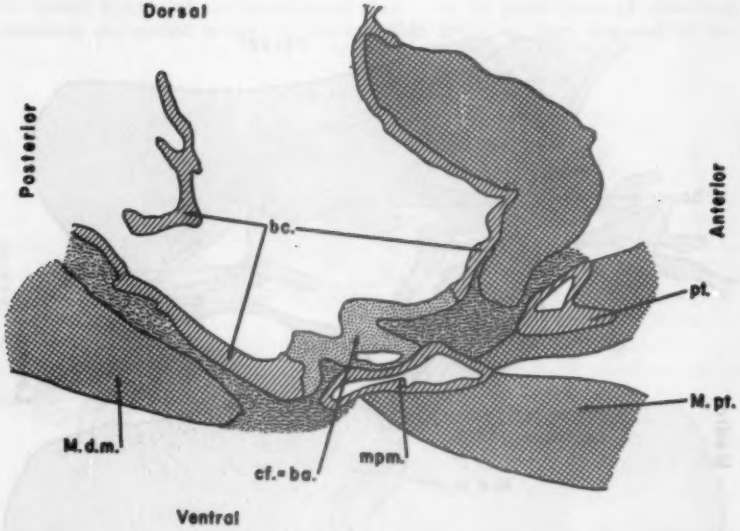

Figure 4. Semischematic longitudinal section through the basitemporal articulation of a plover. The articulation was cut in the plane indicated by line "A-A" in Figure 3. In the figures of histological sections, bone is shown by diagonal lines, muscle by cross-hatching, loose connective tissue by rough lines, and collagenous fibers by stippling. A mass of collagenous fibers connects the medial process of the mandible to the basicranium; this mass of collagenous fibers is the basitemporal articulation. The cavity inside the articulation is not a true articular cavity.

The secondary abutment of the mandible on the brain case may be called *the medial brace of the mandible*, and its articulation may be called *the basitemporal articulation of the mandible*. The two terms may be shortened to the medial brace and the basitemporal articulation when discussing the mandible as will be done in the rest of this paper.

Slides were prepared of the two jaw articulations (right and left) of a Ringed Plover. The sections were cut at 10μ and stained with Ehrlich's hematoxylin and eosin. One articulation was sectioned in the plane indicated by line A-A in Figure 3, while the second was cut along line B-B. Because of the difficulties of cutting bone, I was only able to assemble rough serial sections of each series. Nevertheless, the sections were sufficient to enable me to locate the basitemporal articulation and to determine its structure.

A schematic longitudinal section through the basitemporal articulation is shown in Figure 4. The base of the brain case appears as a thin, wavy line of bone. The medial process of the mandible, which appears as an oblong ring of bone, is slightly separated from the brain case. Between the brain case and the medial process is a heavy mass of collagenous fibers continuous with the two bones. This mass of collagenous fibers is the basitemporal articulation. The cavity seen inside

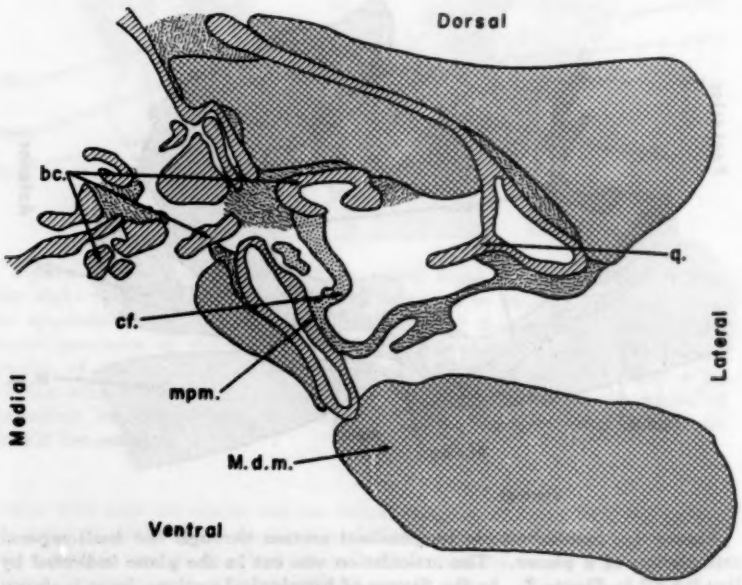

Figure 5. Semischematic cross-section through the basitemporal articulation of a plover. The articulation was cut in the plane indicated by line "B-B" in Figure 3. The thin band of collagenous fibers running from the medial process of the mandible to the basicranium is the anterior edge of the basitemporal articulation.

the fibrous mass, although it is probably not an artifact, is not a true articular cavity. Its function may be to insure sufficient flexibility between the two bones.

In the anterior slides of the cross-sectional series (Figure 5), the medial process of the mandible is present as an oblique ring of bone. Dorsal and lateral to the medial process is the quadrate with its orbital process extending dorsal and medial from the main body of the bone. On the medial edge of the section and slightly dorsal to the medial process of the mandible is the base of the skull, which appears as a jumbled mass of bone because of disruption and crushing during preparation. Slender bands of collagenous fibers run from the medial process of the mandible to the base of the skull; these are the beginnings of the basitemporal articulation. In a more posterior slide (Figure 6), most of the structures seen in the last figure are still present, with the addition of a large mass of collagenous fibers just dorsal to the former position of the now-absent medial process of the mandible. This mass of collagenous fibers is attached to the medial process (seen in intermediate slides) and extends toward the base of the skull as a band of fibers that finally merges into a bone (= the lateral process of the basitemporal plate ?). From its position and connection to both the mandible and the brain case, I have identified this mass of collagenous fibers as the basitemporal articulation. The thickening seen in the middle of the articulation is probably the capping pad on the lateral process of the basitemporal plate. As the more posterior slides are examined, the medial process of the mandible drops out first, followed by the

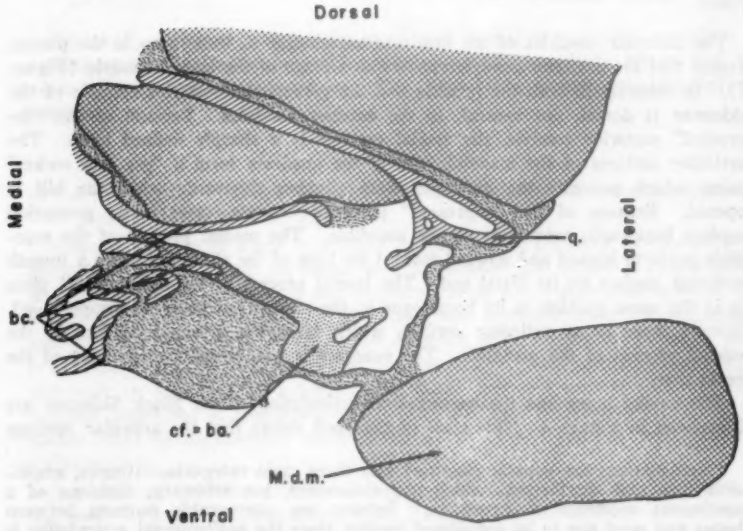

Figure 6. Semischematic cross-section through the basitemporal articulation of a plover. This section is posterior to the section shown in Figure 5. The medial process of the mandible has dropped out, but the basitemporal articulation has become more prominent. The thick knob of collagenous fibers is probably the capping pad found on the lateral basitemporal process.

capping pad on the lateral basitemporal process, until all that remains is the now-prominent base of the skull.

These slides show that the basitemporal articulation in the plover possesses neither articular pads of cartilage nor a true articular cavity, both of which are necessary diagnostic features of a diarthrodial articulation.[1] Instead, the basitemporal articulation of the plover belongs to the class of articulations that are only slightly movable—amphiarthroses—and to the subclass—syndesmoses—because the bones are held together by ligaments (Jackson, 1933: 275; Lewis, 1942: 277). This type of articulation is considered to be intermediate, both morphologically and functionally, between sutures and diarthroses or true articular joints.

The medial brace in the Black Skimmer. The most advanced stage in the development of the medial brace in birds may be seen in the Black Skimmer (*Rynchops nigra*, Rynchopinae). Shufeldt (1890b: 71) described the articulation for the gulls, terns, and skimmer, all members of the Laridae, and stated that it is best developed in the skimmer, which has a true articular joint. He mentioned the very distinct articular surfaces present on the medial process of the mandible and on the lateral basitemporal process in the skimmer, which is doubtless the basis for his statement that the skimmer has a true articular joint.

The articular condyles of the quadrate are similar to those seen in the plover, except that the posterior condyle appears as a ridge of the lateral condyle (Figure 7). In contrast to both the grackle and the plover, the posterior condyle of the skimmer is dorsal, not ventral, to the anterior condyles. Because of the "depressed" posterior condyle, the medial condyle is a sharply defined knob. The articular surfaces of the mandible and of the quadrate form a "peg and socket" joint, which prevents the mandible from slipping sidewards when the bill is opened. Because of the "depressed" posterior condyle, there is no protection against backwards movement of the mandible. The medial process of the mandible projects inward and upward toward the base of the skull and bears a smooth articular surface on its distal end. The lateral process of the basitemporal plate is in the same position as its homologue in the plover, but lacks the capping pad. Instead there is an articular surface, which faces the articular surface in the medial process of the mandible. The quadrate is not braced by any part of the brain case.

The medial brace and the basitemporal articulation of the Black Skimmer are illustrated in Figure 8. This view of the skull shows that the articular surfaces

[1] Articulations are usually classified into three main categories—sutures, amphiarthroses, and diarthroses—which are convenient, but arbitrary, divisions of a continuous spectrum of structures. Sutures are nonmovable contacts between bones and need not to be considered further since the basitemporal articulation is a movable hinge. The difference between amphiarthroses and diarthroses is that, in the former, the bones are simply held together by bands of collagenous fibers, while, in the latter, an articular cavity, articular surfaces of cartilage, and a synovial membrane must be present. For a general discussion of this subject, see Lubosch (1910), who investigated the histological structure of articulations found in all living classes of vertebrates, or any textbook on histology.

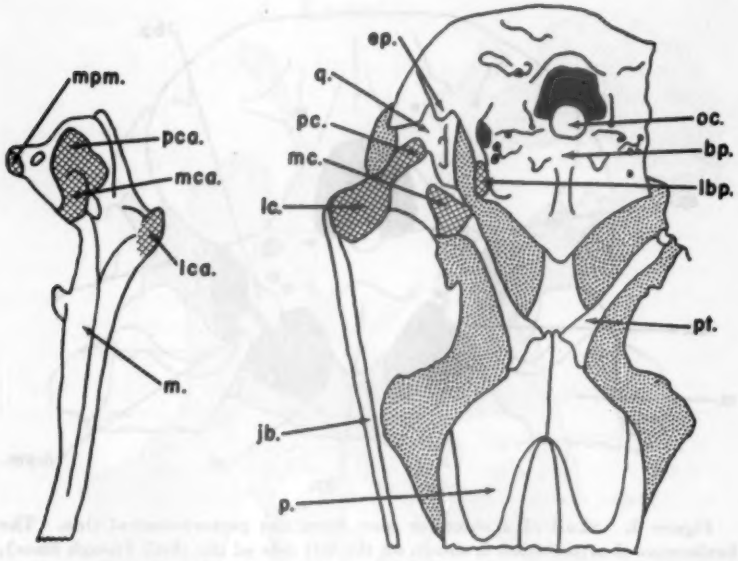

Figure 7. Ventral view of the skull and dorsal view of the mandible of a skimmer. The articular surfaces of both the quadrate hinge and the medial brace are cross-hatched. The deep-lying bones are stippled for contrast.

of the basitemporal articulation are so oriented that the medial brace can withstand both backwards and inwards forces.

Slides of the medial brace of a Black Skimmer were prepared to determine the histological nature of its basitemporal articulation. The entire jaw articulation was removed from a specimen, and the excess bone was trimmed off until all that remained was the medial brace. The tissue was sectioned along the longitudinal axis of the medial brace; however, the direction of sectioning in the radial plane is not known. Sections were cut at 10μ and stained with Ehrlich's hematoxylin and eosin or with Mallory's triple stain. They were not mounted serially. The extreme difficulties of embedding and cutting bird skulls prevented sectioning the medial brace of the skimmer while it was in its natural position and assembling serial sections.

Inspection of a section (Figure 9) reveals that the basitemporal articulation in the Black Skimmer is a true diarthrosis. Pads of articular cartilage on each bone, a typical articular cavity, and articular membrane are all present. The exact size of the cavity and the relationship of the bones to one another cannot be determined from the sections because the bones were moved relative to one another during preparation. Nevertheless, several features of the articulation (not illustrated) deserve closer attention.

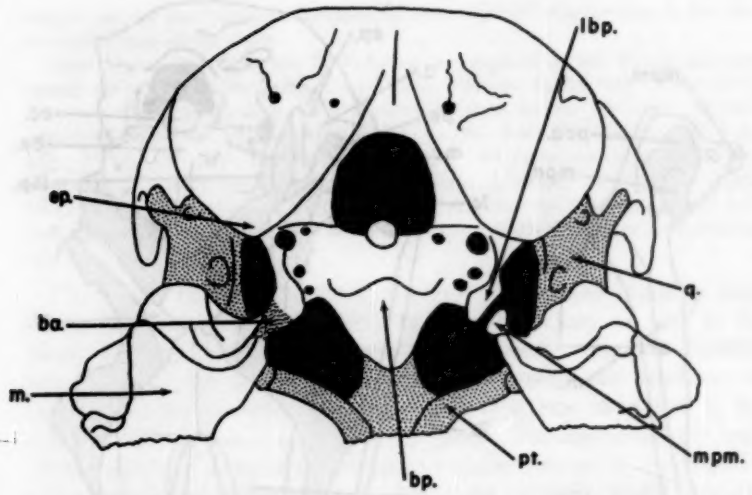

Figure 8. Skull of a skimmer seen from the postero-ventral side. The basitemporal articulation is shown on the left side of the skull (rough lines), but it has been removed on the right side to show the processes of the medial brace. The deep-lying bones are stippled for contrast.

The articular pads are most interesting. Rather than being composed of hyaline cartilage as is usually true for diarthroses, the pads are formed of a dense fibrocartilage. The collagenous fibers run perpendicularly from the bone toward the surface of the articular cartilage, but before they reach the surface, they turn to the side or back on themselves to form a mass of interwoven fibers near the surface of the articular pad. These pads are very similar to those shown by Petersen (1930: Figs. 137a and 141) to illustrate articular pads composed of fibrocartilage. The orientation of the fibers in at least part of the articular pad on the medial process of the mandible is influenced by the insertion of the muscle (probably the M. pterygoideus) seen at the edge of the section. The collagenous fibers associated with the muscle insertion lie parallel to the muscle fibers and thus run across the articular pad and parallel to its surface. Lastly, the surfaces of the articular cartilages are not covered by a squamous epithelium, but are bare of an epithelium and are rough, not smooth as is usual for articular surfaces. This may be, however, an artifact of preparation. Fibrocartilage articular pads may occur when there is much pressure on the articulation. A prime example of fibrocartilage articular pads associated with pressure is the articulations between the thoracic vertebrae in man.

Details of the articular membrane are somewhat obscured because of tearing during preparation. However, the membrane appears to be similar in all respects to typical synovial membranes except that it seems to be looser and more folded than normal, probably to allow the bones to slide further past one another than in most articulations. In some sections, a long tongue of loose connective tissue

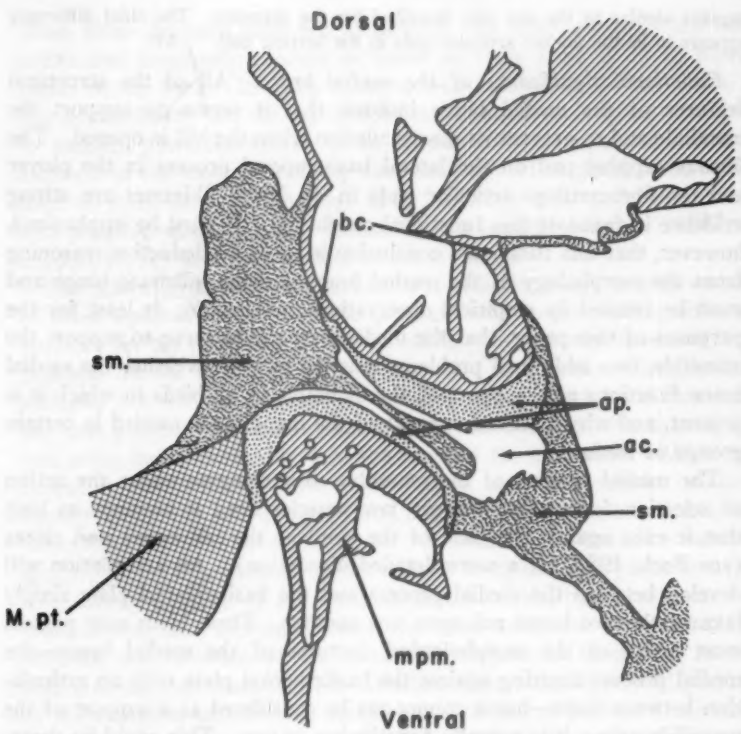

Figure 9. Semischematic longitudinal section through the basitemporal articulation of a skimmer. Note the presence of articular pads, an articular cavity, and synovial membrane, all of which are necessary features of diarthroses. The synovial membrane is shown by rough lines, while the fibrocartilage articular pads are shown by stippling; bone and muscle are the same as in Figure 4.

projects into the articular cavity, and in other sections it may even be continuous across the cavity. I do not know whether this infolding of the synovial membrane is present only at the edges of the articulation or whether it is found throughout the articulation; serial sections are needed to ascertain this point. Membranes or cartilagenous disks have been reported in the cavities of articulations which are subject to pressure. Lastly, it should be noted that the synovial membrane continues without a break into the epimysium surrounding the muscle which inserts on the medial process of the mandible.

I have also obtained some rather poor sections of the basitemporal articulation of the Herring Gull (*Larus argentatus*, Larinae). In all respects, including the fibrocartilage articular pads and the tongue of connective tissue projecting into the articular cavity, the histological structure of the gull basitemporal articulation

appears similar to the one just described for the skimmer. The chief difference appears to be the thicker articular pads in the herring gull.

Functional significance of the medial brace. All of the structural features of the medial brace indicate that it serves to support the mandible and to prevent its disarticulation when the bill is opened. The fibrous capping pad on the lateral basitemporal process in the plover and the fibrocartilage articular pads in the Black Skimmer are strong evidence in favor of this functional conclusion. It must be emphasized, however, that this functional conclusion is based on deductive reasoning from the morphology of the medial brace and the quadrate hinge and must be verified by empirical observations. Assuming, at least for the purposes of this paper, that the medial brace does serve to support the mandible, two additional problems must be solved: whether the medial brace functions as a support of the mandible in all birds in which it is present, and why a second support of the mandible is needed in certain groups of birds.

The medial process of the mandible may elongate under the action of selection forces for stronger jaw muscles until it becomes so long that it rubs against the base of the skull as the bill opens and closes (see Bock, 1959, for a more detailed discussion). An articulation will develop between the medial process and the basitemporal plate simply because the two bones rub upon one another. These birds now possess most or all of the morphological features of the medial brace—the medial process abutting against the basitemporal plate with an articulation between them—but it cannot yet be considered as a support of the mandible unless it is actually functioning as one. This could be determined by the presence of certain specializations such as fibrous articular pads and strengthened processes on the basitemporal plate, or better by actual observations or experiments. If the morphological medial brace was not functioning as a support of the mandible, it could be regarded as being in the preadapted stage. Although this problem is important in discussions on the evolution of the medial brace, it shall not be considered further in this paper. The reader is referred to my other paper (Bock, 1959) for a more complete discussion of this point. I shall assume, for the purposes of this study, that if the medial process of the mandible abuts against the basitemporal plate, then that bird has a functional medial brace.

The question of why some birds need a second support of the mandible may be approached by a consideration of how they catch their food. The forelimbs of birds, being modified into wings, have no direct auxiliary function in the ingestion of food. Only a very few groups, such as the hawks and the owls, use their feet to capture their prey.

Most birds use only their bill in feeding. In addition, birds are very active and frequently capture or break up their food by rapid movements of the head. In many species, food is taken in flight. Thus, it can be concluded that the jaw articulation of birds is frequently subject to sudden, powerful shocks or to asymmetrical forces, and hence is exposed to the danger of being disarticulated. The problem is, therefore, whether the quadrate hinge in all birds can withstand these strong and possibly disarticulating forces on the mandible or is additional support of the mandible needed in some groups.

The articular surfaces of the quadrate-articular hinge usually consist of three separate condyles on the quadrate with corresponding articular surfaces on the articular of the mandible. Some birds have only two condyles on the quadrate, while a very few have four. The quadrate condyles are usually arranged in the shape of a rough horseshoe with the base pointing backwards, condyles at the base and the tips of the two arms, and a cavity between the arms of the horseshoe. Either the lateral or the medial condyle is the largest with the posterior condyle usually appearing as a projection of the lateral condyle, but with some connection with the medial condyle. Sometimes the posterior condyle appears to be a projection of the medial condyle. The posterior condyle usually projects as far ventrally as the others, but sometimes it is more dorsal, *i.e.*, "depressed," than the other condyles. It is difficult to describe the variation of the quadrate condyles in birds, but it will suffice to say that there is great variation in the size, shape, and position of the condyles between the families and orders of birds. Some indication of this variation may be gained through the survey presented below, but even there a great many details are omitted.

The structure of the corresponding articular surfaces on the articular is even more variable than the condyles of the quadrate. In some birds, the articular surfaces of the mandible are well defined, while in others, they are flat. In general, birds may be divided into two groups: those in which the articular encases the condyles of the quadrate, thus preventing backwards and/or sidewards shifting of the mandible, and those in which the articular is flattened and does not clasp the condyles of the quadrate, thus offering limited protection against disarticulation of the mandible. Attention will be focused on the second group. The problem becomes even more complex because the relationships of the articular surfaces shift as the bill opens, with the result that the articular may no longer encase the quadrate condyles. The mandible is depressed by the action of the M. depressor mandibulae, which takes origin from the exoccipital process and inserts on the posterior rim of the mandible including its medial process. Upon contracting, the M.

depressor mandibulae draws the posterior end of the mandible upwards, thereby depressing the rest of the mandible, which pivots on the posterior articular condyle. Therefore, as the bill opens, the articular surfaces of the anterior quadrate condyles lose contact with the corresponding surfaces of the articular. Support of the lower jaw would then rest largely on the posterior condyle. Hence, when the bill is opened while the bird is feeding, the mandible receives the least support from the quadrate at a time when it would need the greatest amount of support; any backwards or sidewards force on the depressed mandible would act mainly on the posterior condyle and the posterior surfaces of the anterior condyles of the quadrate. (In these discussions, all forces on the quadrate hinge within 20 to 30 degrees of the medial plane and in a backwards direction are included within the limits of backwards disarticulation, thereby including most of the possible shifts caused by lateral or twisting forces on the mandible.) If these disrupting forces are strong enough and if the structure of the quadrate hinge is such that it offers only limited protection against disarticulation, *e.g.*, the posterior condyle being dorsal, then it would be advantageous for the bird to have some structure that would provide additional support for the mandible. This extra protection can be provided, of course, by the medial brace of the mandible. It should be noted that the need for extra support of the mandible exists only when the bill is opened, hence the medial brace need be functional only at this time.

If the conclusion that the medial brace functions to support the mandible in compensation for a poorly developed quadrate hinge is correct, then it should be expected that the relative development of the brace is correlated directly with the strength of the force on the depressed mandible and inversely with the ability of the quadrate hinge to withstand these forces. The medial brace of the Boat-tailed Grackle, the Ringed Plover, and the Black Skimmer may be compared to test this latter conclusion.

Grackles feed mainly on insects, seeds, and other small morsels in which the main action of the bill is a forceful bite; hence backwards and probably sidewards forces on the mandible would be small or lacking. The peg and socket arrangement of the quadrate hinge is probably able to withstand all of the forces that may act on the mandible. Thus, the probability of the quadrate hinge of the grackle disarticulating is very small or perhaps even nonexistent, which is in agreement with the absence of the medial brace in this species.

The Ringed Plover feeds by picking up small animals from sand and mud beaches, and this should not result in strong forces on the mandible. However, the articular surfaces of the mandible do not

clasp the quadrate condyles and thus offer little protection against the possible disruption of the quadrate hinge. The slightly developed medial brace of the plover probably provides the extra support needed to compensate for a poorly developed quadrate hinge.

The mandible of the Black Skimmer is subject to quite severe shocks. This bird catches its prey by flying low over the surface of the water and inserting its knifelike mandible into the water. Each time a fish is caught or an obstacle hits the mandible, the head of the skimmer is snapped violently downwards and backwards. The force at which a skimmer hits an obstacle is sometimes great enough to break off the tip of the horny covering of the mandible.[2] As we have seen, the structure of the quadrate hinge in the skimmer is such that it cannot resist a strong backwards movement of the mandible. Therefore, it can be concluded that each time a skimmer catches a fish or hits an underwater obstacle with its bill, there is a strong and sudden force on the mandible while the bill is opened and that the quadrate hinge of the skimmer cannot withstand this force; thus the need for a secondary support of the mandible. The medial brace in the skimmer must be well developed as it probably supplies most of the resistance to the backwards forces on the mandible.

A comparison of these three species supports the conclusion that a flattening of the articular surfaces of the quadrate hinge and/or an increase in the forces acting on the mandible are correlated with a more highly developed medial brace. More examples will be given in the review of the medial brace in birds. The degree of development of the medial brace may be estimated roughly by whether the bones are in contact even when the bill is closed and by the structure of the basitemporal articulation. A disarthrosis with fibrocartilage articular pads indicates a more highly developed medial brace than a syndesmosis.

SURVEY OF THE MEDIAL BRACE AND ASSOCIATED STRUCTURES

The structure and occurrence of the medial brace, the processes of the basicranium, and the quadrate hinge will be described in this section. I shall first outline the general problems associated with each of these structures and then present the details in the synopsis of the families. All material examined is in the skeleton collection of the American Museum of Natural History. The sequence of families used in the synopsis is that presented by Mayr and Amadon (1951).

[2] These observations are partly my own, but they were greatly clarified by a discussion with Dr. Richard Zusi, who is studying the functional anatomy of the feeding methods of the skimmer. I am most grateful to Dr. Zusi for supplying me with these unpublished data.

The medial brace. The first question that arose after the medial brace (hereafter abbreviated as mb.) and the basitemporal articulation (hereafter abbreviated as ba.) were found in the Charadriinae and the Laridae was: How widespread are these structures in birds? Are they restricted to a few families of the Laro-Limicolae? Or are they of widespread occurrence in birds? A survey using dried skulls was undertaken to answer these questions. Although the results of this survey provide much information about the distribution of the medial brace in birds, it must be emphasized that they are preliminary and that much more work is needed before we have an accurate picture of the occurrence and structure of the medial brace and the basitemporal articulation. No attempt was made to examine all available genera of a family, and because dried skulls were used, the observations cannot be considered as conclusive. During preparation of the skeleton, the ligaments between the bones of the brace may tear, the articular pads may dry and fall off the specimen, the quadrate may shift forward, and the mandible may become disarticulated as is the usual case in museum specimens. All these factors contribute toward destroying the basitemporal articulation and the normal position of the bones that constitute the brace, and thus render the specimen unsuitable for observation. Therefore, it is entirely possible that I have overlooked the medial brace in some groups, especially if it is weakly developed, and that I have erroneously reported a medial brace in some groups that do not possess one. For example, early in the study, I examined a dried skull of a gull *(Larus)* and concluded that it did not possess a medial brace. Later dissection of an alcoholic specimen revealed that gulls have a well-developed medial brace, but one with thick articular pads. These pads had dried and dropped off the skull, thereby leaving a gap between the bones of the medial brace. Observations on alcoholic specimens are needed to verify my preliminary findings and to ascertain the exact structure of the brace in groups other than the plovers and the skimmer.

During the course of the survey, it became obvious that the medial brace was not only of widespread occurrence in birds, but that its structure varies greatly between the families and orders of birds. The most significant feature of this variation is not the difference in the morphology of the articulation itself, but the fact that the process of the basitemporal plate on which the medial process of the mandible abuts is not the same in all birds. The medial process of the mandible articulates either with the lateral or the medial process of the basitemporal plate (Figure 10) or with the main body of the plate itself. Variation exists even within these limits as the mandible may abut against the anterior edge or the ventral tip of the lateral basitemporal

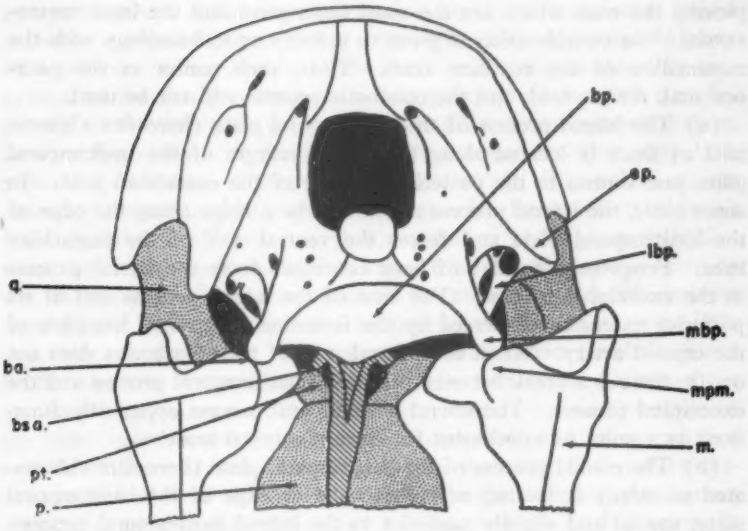

Figure 10. Skull of a California condor *(Gymnogyps)* seen from the postero-ventral side. The medial process of the mandible abuts against the enlarged medial process of the basitemporal plate. The lateral basitemporal process can be seen passing beneath the medial basitemporal process. The deep-lying bones are shaded for contrast.

process. The interesting aspect of this variation is that the medial brace is effective as a support of the mandible no matter which process of the basitemporal plate is involved. This problem is discussed at greater length elsewhere (Bock, 1959).

The bony processes of the basicranium. Once it was discovered that the medial process of the mandible (hereafter abbreviated as mpm.) articulated with two different processes of the basitemporal plate, it became necessary to ascertain the correct names for them. A review of the literature not only failed to produce an acceptable set of names, but revealed an almost hopeless confusion in the terminology for the processes of the basicranium. This confusion was the product of the past few decades, because prior to 1900 there was relatively standard terminology for the processes found on the base of the skull. No general review of these structures has been published since the turn of the century. Unfortunately, Barnikol (1952) did not include the base of the skull in his excellent paper on the factors influencing the shape of the skull. The following set of names is a composite one,

picking the ones which are the most descriptive and the least controversial. No consideration is given to priority or to homology with the mammalian or the reptilian skull. Thus, such names as the paraoccipital, the mastoid, and the opisthotic process will not be used.

(a) The lateral process of the basitemporal plate (hereafter abbreviated as lbp.) is located along the lateral margin of the basitemporal plate just ventral to the posterior opening of the eustachian tube. In some birds, the lateral process appears to be a ridge along the edge of the basitemporal plate and forms the ventral wall of the eustachian tube. Frequently, a ridge of bone continues from the lateral process to the exoccipital process. The base of the lateral process and of its posterior extension is pierced by the foramina for several branches of the carotid artery. When the ventral wall of these foramina does not ossify, there is a break between the lateral basitemporal process and the exoccipital process. The lateral basitemporal process apparently functions as a point of attachment for certain cervical muscles.

(b) The medial process of the basitemporal plate (hereafter abbreviated as mbp.) is located near the posterior edge of the basitemporal plate, medial and slightly posterior to the lateral basitemporal process. Sometimes there is a second pair of very small knobs inside the medial processes. The function of the medial process is apparently to provide a point of attachment for some of the cervical muscles (see Boas, 1929). Fisher (1944: 229) erroneously called this process the exoccipital process, while Pycraft (1902: 280) referred to it as the mammillary process.

(c) The exoccipital process (hereafter abbreviated as ep.) is located on the ventral end of the exoccipital bone and usually projects downwards. It is little more than a ventral extension of the exoccipital bone. In some birds, such as the cormorant, the exoccipital process is horizontal and points to the side. As mentioned above, a ridge of bone frequently connects the exoccipital process with the lateral basitemporal process. The M. depressor mandibulae takes origin from the exoccipital process. This process has been called the paraoccipital, the opisthotic, and the mastoid process as well as the occipital wing.

(d) The auditory bulla can be used for the swollen bulb about the opening of the ear (see Dilger, 1956: 177), although this structure is not homologous with the auditory bulla of the mammals. This swelling is formed by the exoccipital process and the lateral basitemporal process. The squamosal does not take part in its formation, hence it cannot be referred to as "the inflated squamosal area" (Tordoff, 1954: 10). The auditory bulla will not be included in the synopsis.

The quadrate hinge. While examining families for the presence of the medial brace, I became puzzled over the lack of the brace in some

groups in which I had expected to find one. In some cases, I have probably overlooked it as I had later discovered upon checking my observations; but in other cases, the brace is definitely lacking. A comparison of the quadrate hinge in a few groups revealed that it varied greatly in its ability to protect the mandible against disarticulation. In some birds, such as the skimmer *(Rynchops)*, it offers very little protection, while in others, such as *Balaeniceps*, it provides all the necessary protection and support. All possible intermediate steps are found in other birds. It was, thus, considered essential to determine the ability of the quadrate hinge to support the mandible and to correlate this ability with the development of the medial brace. The minute detail of the quadrate suspension is most interesting, but it is of little importance to this study. Consequently, I will restrict the descriptions to the barest necessity, and concentrate attention on the ability of the quadrate hinge to support the mandible. These functional conclusions are based only on observations on the dried skull, and are speculative and inconclusive at best. Observations on the living bird and experiments are needed to ascertain the role of the quadrate hinge and other structures, such as ligaments, jaw muscles, and the medial brace, in supporting the mandible when the bill is opened. The lateral, the posterior, and the medial quadrate condyle will be abbreviated as lc., pc., and mc., respectively. For additional details on the morphology of the quadrate-articular hinge, the reader is referred to such general papers as Lebedinsky (1921).

SYNOPSIS OF FAMILIES

Struthionidae. (a) The mb. appears to be absent in the ostrich, but the mpm. is well developed and approaches the base of the skull when the bill is opened. Perhaps the mb. is present (if so, the articular pads or the connecting bands of collagenous fibers of the ba. have dried and fallen off?). (b) Both the lbp. and the mbp. are absent, but the ep. is well developed. (c) The lc. and the pc. are small and dorsal; the pc. is an extension of the lc. The mc. is the largest and the most ventral of the three condyles. It offers excellent protection against sidewards shifting of the mandible, but only poor protection against backwards disarticulation.

Apterygidae. (a) The mb. is present in the kiwis with the mpm. articulating against the mbp. (b) The lbp. is present but poorly developed and is overshadowed by the well-developed mbp., which is a bony knob well back of the basitemporal plate. The ep. is lateral and well developed. It forms a vertical plate of bone on the back of the skull. (c) The lc. is fused with the pc.; both face laterally. The mc. is the largest and offers good protection against sidewards, but not against backwards, disarticulating forces.

Casuariidae. (a) The mb. is present in the cassowaries (?), with the mpm. articulating with the lbp., or perhaps with the lateral edge of the basitemporal

plate. (b) The lbp. forms a slight ledge along the edge of the basitemporal plate. The mbp. is absent or present as a slight bump. The ep. is well developed and forms a vertical plate of bone on the back of the skull. (c) The lc. is continuous with the pc. to form a flat plate, which faces backwards and outwards. The mc. is the largest condyle but forms a flat plate, which offers little support against either sidewards or backwards disarticulating forces.

Dromaeidae. (a) The mb. is absent in the emus. (b) Both the lbp. and the mbp. are absent. The ep. is present as a flat plate of bone, which does not flare out to the sides as in the kiwis. (c) The lc. and the pc. are joined to form a long articular surface. The mc. is the largest with one articular surface facing outwards. This articular surface has a corresponding abutment on the mandible, which serves to protect the quadrate hinge from disarticulation.

Rheidae. (a) The mb. is absent in the rheas. (b) The lbp. is present (?) as a ridge below the edge of the basitemporal plate, while the mbp. is present as a slight knob. The ep. is well developed. (c) The lc. is small and the most dorsal of the three condyles. The pc. is connected to the lc. and is small. The mc. is the largest and the most ventral. It has an outward-facing articular surface with a corresponding face on the mandible, which may serve to protect the mandible from disarticulation.

Tinamidae. (a) The mb. is probably absent in the tinamous, although one skull showed a peculiar set of processes and articular surfaces, which suggests that a mb. is present in this individual. (b) The lbp. and the mbp. are absent. The ep. is present but not as prominent as in the rheas. (c) The lc. is small and dorsal and is connected to the small, but more ventral, pc. The mc. is large and the most ventral with a lateral articular surface, which could serve to protect the mandible. However, there is not a corresponding articular surface on the mandible. The quadrate hinge of the tinamous does not appear to be able to protect the mandible against disarticulation, but a mb. has not developed.

Spheniscidae. (a) The mb. is present in several genera of penguins, such as *Aptenodytes,* with the mpm. articulating against the mbp., but it is absent (?) in others such as *Spheniscus.* Perhaps the articular pads in these latter genera are thick and have dried out, which would account for the apparent absence of the mb. (b) The lbp. is present as a poorly defined ridge along the margin of the basitemporal plate. The mbp. is also present, but it is well developed. It is found near the lateral edge of the bone and projects more ventral than does the lbp. The ep. is present, but it is poorly developed. (c) The lc. is well developed, while the pc. is small and more dorsal than the others. The mc. is the largest and has a concavity on its lateral edge with a corresponding ridge on the mandible. However, the entire articulation is quite flat and offers little protection against disarticulation of the mandible; therefore, the seeming absence of a mb. in some genera is a puzzle.

Diomedeidae. (a) The mb. is absent in the albatrosses or may be present (?) with the mpm. articulating with the mbp. If the mb. is present, the articular pads are probably very thick, and have dried and dropped off the skull. (b) The lbp. is absent, but the mbp. is present as a prominent knob of bone. The ep. is well developed and extends ventrally. (c) The lc. is well developed with the pc. appearing as a posterior and slightly dorsal continuation. The mc. is the largest condyle and has a groove across it at an angle to the longitudinal axis of the skull. A bony ridge on the mandible fits into this groove and apparently prevents disarticulation of the mandible.

Procellariidae. (a) The mb. is absent in most shearwaters and petrels, but may be present in the largest members of this family, *e.g., Macronectes,* with the mpm. articulating with the mbp. (b) The lbp. is absent. The mbp. is absent in the storm petrels, but present in the shearwaters from weakly developed to well developed in *Macronectes.* The ep. is present and projects ventrally. (c) The quadrate condyles are similar to those in the albatrosses including the groove on the mc., which prevents the disarticulation of the mandible.

Pelecanoididae. (a) The mb. is absent in the diving petrels. (b) Both the lbp. and the mbp. are absent. The ep. is present, but weak. (c) The lc. is a well-defined knob. The pc. is a ridge extending back from the lc.; it is as ventral as the lc. The mc. is a bony ridge at an angle to the other condyles. It has an anterior lip, which apparently serves to protect the mandible against disarticulation.

Podicipitidae. (a) The mb. is present in the grebes with the mpm. abutting against the lbp. (b) The lbp. is present as a poorly developed ridge along the margin of the basitemporal plate, but with some thickening at the point where the mandible articulates with it. The mbp. is present as a slight knob. It is quite posterior and is almost in line with the occipital condyle. The ep. is present and projects ventrally. It extends toward the lbp., but a gap separates the two processes. (c) The lc. is present, but it is quite flat. The pc. is well developed and projects ventrally. It is well separated from the other condyles and apparently prevents sidewards slipping of the mandible. The mc. is a strong knob with a lateral groove and aids the pc. in protecting the mandible. However, the quadrate hinge cannot prevent backwards disarticulation of the mandible, which agrees with the presence of the mb. in this family.

Gaviidae. (a) The mb. seems to be absent in the loons, but it may be present. The mpm. appears to articulate with the weakly developed mbp., with thick articular pads between the bones. Dissection of alcoholic specimens is needed to verify this point. (b) The lbp. is absent. The mbp. is present as a small knob. The ep. is prominent and projects downward and slightly to the side. (c) The lc. is well developed. The pc. is smaller but still well developed. It is more dorsal than the other condyles. The mc. is the largest of the three and has a lateral groove as in the albatrosses. However, the entire hinge is very flat and offers little protection against disarticulation of the mandible. When the bill is open, the mandible slips off the pc. with ease. Thus it seems reasonable to suggest that a mb. may be present to protect the mandible.

Phaëthontidae. (a) The mb. is absent in the tropic birds. (b) The lbp. is absent. The mbp. is present as a well-developed knob. The ep. may be present, but it is not very distinct from the rest of the occipital bone. (c) The lc. is small and rounded, while the pc. is a low ridge; both are quite flat. The mc. is the largest and is quite rounded. The quadrate hinge offers little protection for the mandible. However, the upper jaw is raised when the bill opens, and this could alter the relationships between the articular surfaces of the quadrate hinge, which may then be sufficient to protect the mandible against disarticulation.

Fregatidae. (a) The mb. is absent in the frigate birds. (b) The lbp. is very poorly developed. The mbp. is present as a small knob. The ep. is a slight projection of the occipital plate. (c) The lc. is a well-developed knob, with the pc. slightly dorsal to it. The mc. is long with an overhanging anterior lip. There is a projection on the mandible, which fits into the lip of the mc. This locking device is not well developed; however, it probably does prevent slipping of the mandible.

Phalacrocoracidae. (a) The mb. is present in the cormorants and anhingas with the mpm. abutting against the mbp. (b) The lbp. is absent to weakly developed in some cormorants as a long ridge. The mbp. is a well-developed knob of bone. The ep. is high above the base of the skull and extends to the side. There is some question whether the ep. in the Phalacrocoracidae is homologous with that process in other groups of birds. (c) The lc. is well developed with the pc. being dorsal. The mc. is well developed with an overlapping anterior lip, which fits over a corresponding lip on the mandible. This locking device appears to be sufficient to protect the mandible against sidewards disarticulation; however, there is little protection against backwards slipping, which is the reason for the development of the mb. in this group.

Sulidae. (a) The mb. appears to be absent in the boobies, but it may be present. (b) The lbp. is absent, but the mbp. is well developed. It projects ventrally and appears to have an articular surface on its lateral surface. The ep. is present but does not project strongly downward. A ridge connects the ep. with the lbp. (c) The lc. is a well-developed knob. The pc. is more dorsal than the others. The mc. is oblong in shape and has an anterior lip, which locks with a corresponding lip on the mandible. This mechanism appears sufficient to protect the mandible, but the shift in these structures when the bill opens may reduce their effectiveness and may necessitate the development of a mb.

Pelecanidae. (a) The mb. is absent in the pelicans. (b) Both the lbp. and the mbp. are absent. The ep. is present as a thick projection of the occipital plate. (c) The lc. and the pc. are both flat and equally ventral in position. The mc. is better developed and is more ventral with a long, curved, but poorly developed ridge, which fits into a groove on the mandible; this tongue and groove mechanism may, however, serve to protect the mandible against disarticulation. The quadrate hinge of the pelicans is really quite poor, but there is probably little stress on it.

Accipitridae. (a) The mb. is probably absent in most accipitrine hawks, although it is present in some of the larger genera, *e.g., Gyps,* with the mpm. articulating with the mbp. In a few, the articulation may be with the lbp. (?). (b) The lbp. is present as a ridge along the margin of the basitemporal plate. The mbp. is absent in most genera, but it is present in some of the larger forms and is very well developed in the large vultures such as *Gyps.* In fact, the skull morphology of the large species of the Old World vultures is remarkably similar to that in the New World vultures. The ep. is well developed and connected to the lbp. by a ridge of bone. (c) The lc. is small and the most dorsal. It is continuous with the pc.; both are relatively flat. The mc. is the best-developed and the most-ventral condyle; however, it does not supply much protection for the mandible. Why the mb. is lacking in most of the true hawks is a mystery, for it is expected because of the structure of the quadrate hinge and the feeding habits of the hawks.

Falconidae. (a) The mb. is present in the falcons with the mpm. abutting against the lbp. (b) The lbp. is well developed; however, the mbp. is absent. The ep. is well developed and is continuous with the lbp. (c) The lc. and the pc. are connected with one another and are flat. The mc. is the most ventral and is a rounded knob of bone; however, it does not provide sufficient protection against disarticulation of the mandible.

Pandionidae. (a) The mb. is absent in the osprey. (b) The lbp. is weakly developed as is the mbp., which is present as a slight knob. The ep. forms a

short ventral projection of the occipital bone. (c) The lc. and the pc. are continuous with one another and are relatively flat. The mc. is larger, more ventral, and rounder with a slight anterior overhang, which apparently helps to support the mandible.

Cathartidae. (a) The mb. is present in the New World vultures, with the entire posterior border of the mpm. involved in the articulation. In the smaller forms, such as *Cathartes* and *Coragyps*, the mpm. abuts against the lbp., while in the larger genera, such as *Gymnogyps* and *Vultur*, the mpm. articulates with the mbp. *Sarcoramphus* appears to be intermediate in the structure of its mb. (b) The lbp. is present, but as a low ridge along the margin of the basitemporal plate. The mbp. is present and varies from poorly developed to strongly developed. The ep. is a well-developed ventral extension of the occipital bone and is connected to the lbp. by a ridge of bone. (c) The lc. is small and the most dorsal with the pc. appearing as a posterior extension; both condyles are relatively flat. The mc. is the largest with a slight anterior lip, which fits into a corresponding ridge on the mandible. This mechanism apparently prevents sidewards slipping of the mandible, but offers little protection against backwards slipping.

Sagittariidae. (a) The mb. is present in the secretary bird with the mpm. articulating with the ventral tip of the lbp. (b) The lbp. is present as a prominent ridge along the margin of the basitemporal plate and is continuous with the poorly developed ep. The mbp. is absent. (c) The lc. is the most dorsal and is quite flat. The pc. is a thin ridge running from the lc., and although it is more ventral than the lc., it is still poorly developed. The mc. is the best developed and the most ventral. It is oblong and thin with a slight anterior lip, which hooks into a corresponding lip on the mandible. However, this locking device is not sufficient to prevent disarticulation of the mandible.

Ardeidae. (a) The mb. appears to be absent in most herons; however, the mpm. may abut against the body of the basitemporal plate when the bill is opened. The mb. is present in the boat-billed heron *(Cochlearius)* in which the mpm. articulates with the ventral edge of the lbp. A similar mb. may be present in a weakly developed state in the night-herons *(Nycticorax)*. (b) The lbp. is present in some herons as a weakly developed ridge along the edge of the basitemporal plate. It is best developed in *Cochlearius*. The mbp. is absent. The ep. is present but weakly developed. (c) The lc. is well developed as are the pc. and the mc. A deep hollow separates them. All condyles are equally ventral. The mc. has an anterior lip, which fits into a weakly developed lip on the mandible. This structure is apparently sufficient to protect the mandible from disarticulation except in the wider-billed night-herons and the broad-billed boat-billed herons. In the latter form, there must be a strong force on the mandible when the bird is feeding that has necessitated the development of the mb.

Threskiornithidae. (a) The mb. is absent in the ibises and spoonbills. (b) The lbp. is only weakly developed as is the mbp., which is a low knob of bone. The ep. is directed laterally but is still quite ventral. (c) The lc. is flat and dorsal. The pc., which is a continuation of the lc., is more ventral and rounder. The mc. is the best developed and is oblong. It is divided by a lateral groove as in the storks. Apparently, the quadrate hinge is sufficient to prevent disarticulation of the mandible. The quadrate condyles of the spoonbills are most peculiar in that they are pushed together, have flat surfaces and face forward, but they are apparently sufficient to support the mandible.

Ciconiidae. (a) The mb. is absent in the storks. (b) The lbp. is absent or

very slightly developed as is the mbp. The ep. is a poorly developed ventral projection. (c) The lc. is small and more dorsal than the others. The pc. is an extension of the lc., but it is larger and more rounded than that condyle. The mc. is the largest and is oblong in shape. Its lateral end is separated from the rest of the condyle by a groove. A ridge on the mandible fits into this groove and serves to protect the mandible. In *Balaeniceps,* the mc. is cut by two longitudinal grooves, one dorsal and one ventral, with corresponding ridges on the mandible. This double-locking device is extremely effective and serves to protect the mandible of the shoe-bill against any possible disarticulation.

Scopidae. (a) The mb. is absent in the hammerhead. (b) The lbp. is slightly developed, while the mbp. is absent. The ep. is only slightly developed. (c) The lc. is well developed and rounded. The pc. is a ridgelike extension of the lc. The mc. is oblong in shape and at right angles to the longitudinal axis of the bill. It has incurved surfaces on its lateral end into which a boss on the mandible fits. Apparently, this structure is sufficient to protect the mandible.

Phoenicopteridae. (a) The mb. is absent in the flamingos. (b) The lbp. appears to be absent. The mbp. is present as a long ridge that ends in a slight knob. It is difficult to be certain whether this ridge is the lbp. or the mbp. The ep. is present as a downward projection of the occipital plate. (c) The lc. is the most dorsal and is flat in shape. The pc. is a bit larger and more rounded than the lc. The mc. is the largest and the most ventral. It is oblong and has a lateral concavity. The quadrate hinge apparently provides enough protection for the mandible.

Anatidae. (a) The mb. is absent in the ducks and geese. (b) Both the lbp. and the mbp. are absent. The ep. is present as a prominent ventral projection of the occipital plate. (c) The lc. is the largest and the most ventral. The pc. appears to be absent or may be present as a knob of the lc. that does not take part in the articulation. The mc. is small and dorsal. In the mergansers, a distinct groove separates the lc. and the mc. The quadrate articulation of the ducks is very flat and appears to be insufficient to prevent disarticulation of the mandible, but a mb. is not present. Perhaps the enlarged posterior process of the mandible supports the mandible in some unsuspected way.

Anhimidae. (a) The mb. is absent in the screamers. (b) The lbp. is present. A pair of low bumps on the middle of the basitemporal plate may represent the mbp. The ep. is present and extends into the lbp. without a break. (c) The lc. is the largest and the most ventral condyle. The pc. appears to be absent. The mc. is small and dorsal. As in the ducks, the quadrate hinge supplies little protection for the mandible, although it may be enough to prevent disarticulation of the mandible.

Megapodiidae. (a) The mb. is absent in the megapodes. (b) The lbp. is present as a short, marginal ridge. The mbp. is absent (?), or may be present as a low bump. The ep. is present and fused with the lbp. (c) The lc. is the largest and the most ventral condyle. The pc. is absent, while the mc. is smaller and more dorsal than the lc. The quadrate hinge in the megapodes does not seem sufficient to protect the mandible, yet no mb. has developed.

Cracidae. (a) The mb. is absent in the guans and curassows. (b) The lbp. is present but less prominent than in the megapodes. The mbp. is absent. The ep. is present and fused with the lbp. (c) The quadrate condyles are similar to those of the megapodes except that the mc. extends as far ventral as the lc. Again, the quadrate hinge does not appear sufficient to support the mandible.

Phasianidae. (a) The mb. is absent in the pheasants and grouse. (b) The lbp. is absent except in the Numidinae in which it is a prominent, rounded knob. The mbp. is absent. The ep. is present and fused with the lbp. or the lateral edge of the basitemporal plate. (c) The quadrate condyles are similar to those of the megapodes, but a deep groove separates the lc. and the mc. The quadrate hinge provides little protection for the mandible, and it is a puzzle why a mb. does not exist in this family.

Meleagrididae. (a) The mb. is absent in the turkeys. (b) The lbp. is present but small. The mbp. is apparently absent. The ep. is present and fused with the lbp. (c) The quadrate condyles are similar to those found in the Phasianidae. The quadrate hinge of the turkeys is a poor one and apparently does not supply sufficient support for the mandible against disarticulation.

Opisthocomidae. (a) The mb. may be present in the hoatzin, but the specimen examined was damaged. (b) The lbp. is a prominent projection with what appears to be an articular surface in its lateral face. The mbp. is absent. The ep. is present and continuous with the lbp. (c) The lc. is about equal in size to the mc. The pc. is absent, although the lateral half of the mc. may represent the pc. The quadrate hinge of the hoatzin is a poor one and supplies little protection for the mandible.

Musophagidae. (a) The mb. is present in the turacos with the mpm. abutting against the ventral edge of the lbp. (b) The lbp. is well developed. The mbp. is absent. The ep. is present and continuous with the lbp. (c) The lc. is small and somewhat rounded. The pc. is very small and dorsal. The mc. is the largest, most rounded, and the most ventral; however, the quadrate hinge is a poor one and does not protect the mandible against disarticulation.

Cuculidae. (a) The mb. is present (?) in the cuckoos with the basal part of the mpm. articulating with the anterior edge of the lbp. (b) The lbp. is large and well developed. The mbp. is absent. The ep. is present and continuous with the lbp. (c) The quadrate condyles are similar to those found in the turacos except that the mc. has an anterior overhang; however, the quadrate hinge provides little protection for the mandible.

Cariamidae. (a) The mb. is present in the seriamas with the mpm. abutting against the anterior edge of the lbp. (b) The lbp. is a very prominent but thin ridge of bone along the margin of the basitemporal plate. The mbp. is present as a small knob. The ep. is present and continuous with the lbp. (c) The lc. is continuous with the pc.; both are flat and separated from the mc. by a wide groove. The mc. is prominent and well rounded, but it is not like that in the cranes. This quadrate hinge is a poor one and does not provide sufficient protection for the mandible.

Psophiidae. (a) The mb. is present in the trumpeters with the mpm. abutting against the anterior edge of the lbp. (b) The processes of the basicranium are similar to those of the Cariamidae. (c) The lc. is continuous with the pc.; both are somewhat rounded. The mc. is oblong and with a concavity on its lateral edge. The quadrate hinge is a poor one and offers little protection for the mandible.

Gruidae. (a) The mb. is present in the cranes with the mpm. articulating with the anterior edge of the lbp. (b) The lbp. is present as a blunt, rounded knob. A small mbp. is present immediately behind the lbp. The ep. is prominent and continuous with the lbp. (c) The lc. and the pc. are continuous with each other and are flat. The mc. is oblong and with a concavity on its lateral end, much like

that seen in the storks. The quadrate hinge is a poor one and apparently offers insufficient support for the mandible.

Aramidae. (a) The mb. is present in the limpkin with the mpm. abutting against the anterior edge of the lbp. (b) The lbp. is a prominent, rounded knob. The mbp. is only slightly developed. The ep. is present and continuous with the lbp. (c) The quadrate condyles are very similar to those found in the Psophiidae and the Gruidae; consequently, the quadrate hinge of the limpkin offers little protection for the mandible.

Eurypygidae. (a) The mb. is present in the sun bitterns with the mpm. abutting against the anterior edge of the lbp., or perhaps with the anterior edge of the basitemporal plate itself. Further study is needed to clarify this point. (b) The lbp. is present as a very low ridge. The mpb. is absent. The ep. is present and continuous with the lbp. (c) The lc. is large and rounded. The pc. is smaller but still rounded. The mc. is oblong but short and with a concavity at its lateral end similar to that seen in the cranes. The quadrate hinge is a poor one and offers little protection for the mandible.

Heliornithidae. No specimens of the sun grebes were available for study.

Rhynochetidae. (a) The mb. is present in the kagu with the mpm. abutting against the anterior edge of the lbp. (b) The lbp. is a heavy, blunt process. The mbp. is present (?) as a small knob close to and almost continuous with the lbp. The ep. is present and continuous with the lbp. (c) The lc. is the largest and the most-rounded condyle. The pc. is small and continuous with the lc. The mc. is small and with a slight concave surface on its lateral end. This is a poor hinge and offers little support for the mandible.

Otididae. (a) The mb. is present in the bustards with the mpm. articulating with the anterior edge of the lbp. (b) The lbp. is prominent, while the mbp. is absent (?) or present as a low knob just behind the lbp. The ep. is present and continuous with the lbp. (c) The lc. and the pc. are continuous with one another; both are flat. The mc. is well developed and the most ventral condyle, although it is the smallest condyle. It has a concavity on its lateral end. However, the quadrate hinge is a poor one and does not support the mandible.

Rallidae. (a) The mb. is present in the rails with the mpm. articulating with the anterior edge of the lbp. or with the ventral tip of the lbp. in a few forms such as *Gallinula* and *Fulica*. (b) The lbp. is well developed, while the mbp. is absent. The ep. is poorly developed, but it is continuous with the lbp. (c) The lc. is flat and slightly dorsal to the others. The pc. is a rounded extension of the lc. The mc. is larger and more rounded with a concavity on its lateral end. Yet, the quadrate hinge of the rails is a poor one and offers little support for the mandible.

Mesoenatidae. No specimens of the roatalos were available for study.

Turnicidae. (a) The mb. is present in the button quails with the mpm. articulating with the ventral edge of the lbp. (b) The lbp. is present and well developed, while the mbp. is absent. The ep. is present and continuous with the lbp. (c) The lc. is the largest condyle with the small pc. appearing as a posterior extension. The mc. is smaller than the lc., but it is quite prominent and more ventral than the lc. The quadrate hinge is a poor one and apparently offers little support for the mandible.

Jacanidae. (a) The mb. is present in the jacanas with the mpm. articulating with the ventral edge of the lbp. (b) The lbp. is well developed and apparently separated from the ep. The mbp. is absent. The ep. is present as a downward

projection of the occipital plate. (c) The lc. is large and rounded as are the smaller pc. and the subequal mc. However, the quadrate hinge is a poor one and provides little protection for the mandible.

Thinocoridae. (a) The mb. is present in the seed snipes with the mpm. articulating with the ventral edge of the lbp. (b) The lbp. is well developed, while the mbp. is absent. The ep. is present and continuous into the lbp. (c) The lc. is continuous with the pc.; both are only slightly rounded. The mc. is small, but it is the most ventral and the most rounded. However, the quadrate hinge offers little protection against disarticulation of the mandible.

Chionididae. (a) The mb. may be present in the sheath bills with the mpm. articulating with the ventral edge of the lbp., but further study is needed to verify this point. (b) The lbp. is present and well developed. The mbp. is very slightly developed. The ep. is a very well-developed, ventral projection of the occipital plate. (c) The lc. is large but flat. The pc. is level with the lc. and is somewhat rounder. The mc. is oblong with a slight concavity on its lateral end. The quadrate hinge is a poor one and seems to offer little protection for the mandible, hence a mb. would be expected to exist in this family.

Dromadidae. No specimens of the crab plover were available for study.

Burhinidae. (a) The mb. is present in the thick-knees with the mpm. articulating with the ventral edge of the lbp. (b) The lbp. is slightly developed. The mbp. is present but very poorly developed. The ep. is present and separated from the lbp. (c) The lc. is continuous with the pc.; both are flat. The mc. is well developed with a small concavity on its lateral end. The quadrate hinge apparently does not provide sufficient protection for the mandible.

Haematopodidae. (a) The mb. is present in the oystercatchers with the mpm. articulating with the anterior edge of the blunt lbp. (b) The lbp. is blunt, heavy, and separated from the ep. The mbp. is just behind the lbp. and is almost fused with it. The ep. is present. (c) The lc. is flat and rather dorsal. The pc. is continuous with the lc. but is more rounded and more dorsal. The mc. is oblong with a concavity on its lateral end. The quadrate hinge of the oystercatcher apparently cannot protect the mandible from disarticulating.

Charadriidae. (a) The mb. is present in some members of the shorebirds, notably the plovers, with the mpm. articulating with the ventral tip of the lbp. It is absent in the Scolopacinae (except *Numenius* ?), the Phalaropinae, the Recurvirostrinae, and perhaps the Rostratulinae (not seen). (b) The lbp. is well developed only in the plovers. It is absent or poorly developed in the others. The mbp. is absent in all. The ep. is rather well developed but separated from the basitemporal plate in all subfamilies. (c) The lc. is flat and dorsal in all. The mc. is oblong to rounded with a concavity on its lateral end. The pc. is variable. In the plovers, it is more ventral than the lc., but it is still quite flat; hence the quadrate hinge in this subfamily cannot protect the mandible. In the other subfamilies, the pc. is well developed and quite ventral; hence the quadrate hinge is probably able to protect the mandible from disarticulating.

Glareolidae. (a) The mb. is present in the pratincoles and the coursers with the mpm. articulating with the ventral edge of the lbp. (b) The lbp. is well developed, while the mbp. is absent. The ep. is present and continuous with the lbp. (c) The lc. is large and rounded. The pc. is smaller and dorsal. In *Glareola*, it is very dorsal and very similar to that seen in the skimmer. The mc. is ventral and rounded. It is quite prominent. The quadrate hinge is, therefore,

unable to protect the mandible from disarticulating in a backwards direction, although it can prevent sidewards slipping.

Laridae. (a) The mb. is present in the gulls, terns, and skimmer with the mpm. articulating with the ventral edge of the lbp. It is absent in the jaegers (Stercorariinae). (b) The lbp. is present and well developed except in the jaegers in which it is weakly developed. Th mbp. is absent to slightly developed. The ep. is present and continuous with the lbp. (c) The lc. is large and rounded in all subfamilies as is the mc., which is the most ventral condyle. In the jaegers, the pc. is small and dorsal, but with an anterior concavity. A knob on the mandible fits into this concavity and thus protects the mandible against disarticulation. In the others, the posterior condyle is dorsal and without a cavity; the corresponding knob on the mandible is also lacking. In these subfamilies, the quadrate hinge cannot protect the mandible against backwards disarticulation.

Alcidae. (a) The mb. seems to be absent in the auks, but it may be present with the mpm. articulating with the weakly developed mbp. Dissections are needed to clarify this problem. (b) The lbp. is very poorly developed, while the mbp. is only slightly better developed. The ep. is present and rounded at its distal end. It is separated from the basitemporal plate. (c) The lc. is the largest condyle, but it is rather flat. The pc. is dorsal, but seems to offer some protection for the mandible. The mc. is small, but rounded, ventral, and with a slight concavity on its lateral end. It is not clear whether the quadrate hinge in the auks can provide sufficient protection for the mandible.

Pteroclidae. (a) The mb. is present in the sand grouse with the base of the mpm. articulating with the ventral tip of the lbp. (b) The lbp. is well developed and quite prominent . The mbp. is absent. The ep. is well developed and continuous with the lbp. (c) The lc. is the largest and is continuous with the small pc. The mc. is small but the most rounded. However, all condyles are very flat; hence, the quadrate hinge can offer limited protection for the mandible.

Columbidae. (a) The mb. is absent in the pigeons. (b) Both the lbp. and the mbp. are absent. The ep. is present and continuous with the edge of the basitemporal plate. (c) The lc. is small and slightly dorsal. The pc. appears to be absent. The mc. is large, oblong, and well rounded. It is apparently sufficient to protect the mandible from disarticulation.

Raphidae. Published figures of the skull suggest the possibility that the mb. is present in the dodos. The mb. would be with the mpm. articulating with the well-developed lbp.

Psittacidae. (a) The mb. is absent in the parrots. (b) The lbp. may be present in the shape of a lateral ridge on the basitemporal plate. The mbp. is absent. The ep. is present and continuous with the edge of the basitemporal plate. (c) The lc. is small and very dorsal. The pc. is absent. The mc. is large and ventral and is probably the sole functional articular condyle of the quadrate hinge. The quadrate hinge does not appear to offer sufficient protection for the mandible, but there may be little if any backwards force on the mandible. Or, perhaps, the large posterior process of the mandible may, in some way, serve to protect the mandible against disarticulation.

Strigidae. (a) The mb. is absent in the owls (?), but there is a slight indication of an articulation between the mpm. and the anterior edge of the lbp. (b) The lbp. is weakly developed. The mbp. is absent. The ep. is well developed and continuous with the edge of the basitemporal plate. (c) The lc. is continuous with the pc.; both are dorsal and flat. The mc. is large, rounded, and with an

anterior lip. There is a corresponding lip on the mandible. This locking device apparently serves to protect the lower jaw from disarticulation.

Aegothelidae. No specimens of the owlet frogmouths were available for study.

Podargidae. (a) The mb. is probably absent in the frogmouths. (b) The lbp. is present and lies against the quadrate. The mbp. is absent. The ep. is present and fused with the lbp. (c) The lc. is continuous with the pc.; both are dorsal and flat. The mc. is large and ventral. It has an anterior lip, which hooks into a ridge of the mandible. This locking mechanism apparently serves to protect the mandible against disarticulation.

Caprimulgidae. (a) The mb. is present in the goatsuckers with the very short mpm. articulating with the lbp. Because the lbp. abuts against the quadrate, it is probable that the articular cavity of the ba. is continuous with that of the quadrate hinge. Unfortunately, Fourie (1955: 202) stopped his histological investigations of the quadrate hinge in *Caprimulgus* just anterior of the ba. In his Figure 15c, some strands of connective tissue can be seen running from the mpm. to the basitemporal plate (not labeled); these may represent the anterior end of the ba. (b) The lbp. is well developed and abuts against the quadrate. The mbp. is absent. The ep. is present and fused with the lbp. (c) The lc. is small and rounded. The pc. is absent. The mc. is elongated and separated from the lc. by a sharp groove. The quadrate hinge in the goatsuckers is a poor one and seems unable to provide adequate protection for the mandible.

Nyctibiidae. No specimens of potoos were available for study, but it seems likely that they are similar to the Caprimulgidae in their jaw suspension.

Steatornithidae. (a) The mb. is absent in the oilbird. (b) Both the lbp. and the mbp. are absent. The ep. is present. (c) The lc. is small and dorsal. The pc. is larger and more ventral. The mc. is the largest of all and has a small anterior lip. This quadrate hinge appears to be able to protect the mandible from disarticulation.

Trogonidae. (a) The mb. is absent in the trogons. (b) The lbp. is poorly developed, while the mbp. is absent. The ep. is present and continuous with the lbp. (c) The lc. is dorsal, somewhat rounded, and continuous with the pc. The pc. is more rounded and ventral, as is the large mc. These last two condyles enable the quadrate hinge to protect the mandible from disarticulation.

Coraciidae. (a) The mb. may be present in the rollers with the base of the mpm. articulating with the anterior edge of the lbp.; however, further study is needed to verify this point. (b) The lbp. is present and well developed. The mbp. is present as a small knob. The ep. is well developed and continuous with the lbp. (c) The lc. is flat and dorsal in position. The pc. is even flatter and more dorsal. Although the prominent mc. is large and rounded with an anterior lip, it does not seem sufficient to protect the mandible from disarticulation.

Alcedinidae. (a) The mb. is present in the kingfishers, with the mpm. articulating with the anterior edge of the lbp. (b) The processes of the basicranium are similar to those in the Coraciidae. (c) The quadrate condyles are similar to those seen in the rollers, except that the pc. and the mc. are better developed and more ventral. However, the quadrate hinge is not sufficient to protect the mandible from disarticulating.

Meropidae. (a) The mb. may be present in the bee-eaters as in the rollers. (b) The processes of the basicranium are similar to those in the Coraciidae. (c) The quadrate condyles are similar to those in the Coraciidae, but the lc. is as

far ventral as the mc. Hence the quadrate hinge is not able to provide sufficient protection for the mandible.

Momotidae. (a) The mb. may be present in the motmots as in the rollers. (b) The processes of the basicranium are similar to those in the Coraciidae. (c) The quadrate condyles are similar to those in the Coraciidae; hence the quadrate hinge cannot protect the mandible against disarticulation.

Todidae. No specimens of todies were available for study, but it is suspected that they are similar to the motmots in the structure of their jaw suspension.

Upupidae. (a) The mb. may be present in the true hoopoes as in the rollers. (b) The processes of the basicranium are similar to those found in the Coraciidae. (c) The lc. is small and flat. The pc. is elongate and projects back beyond the quadrate hinge. It is flat. The mc. is oblong with a concavity on its lateral edge. The quadrate hinge is a poor one and apparently cannot provide sufficient protection for the mandible.

Bucerotidae. (a) The mb. is absent in the hornbills. (b) The lbp. is small. The mbp. is small but well developed. The ep. is small and rounded but continuous with the lbp. (c) The lc. is small, flat, and dorsal, as is the pc. The mc. is large, rounded, and has some anterior overhang. However, the quadrate hinge is able to provide sufficient protection for the mandible.

Coliidae. (a) The mb. is present in the mousebirds, with the mpm. articulating with the ventral edge of the lbp. This observation has been confirmed by Starck, who dissected an alcoholic specimen of *Colius* (personal communication). (b) The lbp. is present and well developed. The mbp. is absent. The ep. is present and continuous with the lbp. (c) The lc. is small and rounded. The pc. is small, flat, and dorsal. The mc. is large, oblong, and the most ventral. Yet, the quadrate hinge is apparently not able to provide sufficient protection for the mandible.

Apodidae. (a) The mb. is absent in the swifts. (b) The lbp. is well developed and lies next to the quadrate. The mbp. is present as a small knob. The ep. is present and continuous with the lbp. (c) The lc. is small and dorsal. The pc. is absent. The mc. is large and oblong. It is apparently sufficient to protect the mandible against disarticulation.

Trochilidae. (a) The mb. is absent in the hummingbirds. (b) The processes of the basicranium are similar to those in the swifts except that the ep. is better developed. (c) The quadrate condyles are similar to those in the swifts; hence the quadrate hinge is able to protect the mandible against disarticulation.

Bucconidae. (a) The mb. is absent in the puffbirds. (b) The lbp. is poorly developed. The mbp. is absent. The ep. is present and continuous with the lbp. (c) The lc. is well developed and rounded. The pc. is more dorsal but still rounded. The mc. is large, rounder, and the most ventral. The quadrate hinge is well developed and able to protect the mandible against disarticulation.

Galbulidae. (a) The mb. is absent in the jacamars. (b) The processes of the basicranium are similar to those in the Bucconidae. (c) The lc. is flat and dorsal, as is the pc. The mc. is a well-developed projection. However, the quadrate hinge does not appear to be able to protect the mandible against disarticulation.

Capitonidae. (a) The mb. is absent in the barbets. (b) The processes of the basicranium are similar to those in the Bucconidae. (c) The quadrate condyles are similar to those in the Bucconidae; hence the quadrate hinge is able to protect the mandible.

Picidae. (a) The mb. is absent in the woodpeckers. (b) The lbp. is present and well developed. The mbp. is absent. The ep. is well developed and continuous

with the lbp. (c) The lc. is flat, while the pc. is slightly rounded. The mc. is the largest and the most rounded. The quadrate hinge is probably able to protect the mandible from disarticulating.

Ramphastidae. (a) The mb. may be present in the toucans, with the base of the mpm. articulating with the ventral edge of the lbp.; however, further study is needed to clarify this point. (b) The lbp. is well developed, while the mbp. is only poorly developed. The ep. is well developed and continuous with the lbp. (c) All the quadrate condyles are flat and in the same plane. This hinge is a poor one and apparently unable to protect the mandible from disarticulating.

Indicatoridae. No specimens of the honey guides were available for study.

Passeres. (a) The mb. is absent in all passerine birds examined, but whether it is absent in all members of the order is unknown. (b) The lbp. is well developed as a thin ridge along the margin of the basitemporal plate. In many passerine birds, it abuts against the quadrate and supports that bone against inward displacement. The mbp. is absent or present as a very small bump. The ep. is well developed and continuous with the lbp. In fact, these two processes are fused in many forms and in some are swollen to form a distinct auditory bulla. (c) The lc. is flat and dorsal. The pc. is usually more rounded and more ventral than the lc., but sometimes it is more dorsal. The mc. is always the largest, most-ventral, and most-rounded condyle. It may have a slight anterior overhang. A ridge on the mandible fits into this overhang and thus protects the mandible from disarticulation.

DISCUSSION AND FUTURE PROBLEMS

This section could better be titled just "Future studies," as we know virtually nothing about the medial brace other than the fact that it exists. The purpose of this paper is to record the presence of the medial brace and give a rough idea of its function and its occurrence in birds. We now need detailed studies on its structure and on its functional significance in the many different birds possessing a medial brace. Comparative studies of birds possessing and lacking the medial brace are needed so that we can ascertain the significance of the brace in the mechanics of the jaw apparatus. In fact, the rediscovery of the medial brace has one very discouraging note in that most or all of the past studies on the mechanics of the jaw apparatus, and especially of the lower jaw, must be reexamined and reevaluated if not done anew. In this connection, more work must be done on the structure and function of the quadrate hinge in relation to the forces on the mandible. More studies are also needed on the medial process of the mandible and on the jaw muscles and ligaments attaching to the mandible. It is hoped that some experimental investigations can be done on the function of the medial brace. Although I have not attempted it, it seems possible to approach the medial brace from the medial side of the M. depressor mandibulae and sever the basitemporal articulation or the process of the basitemporal plate, thereby destroying the medial brace. Experiments

would then be done to determine the importance of the medial brace in supporting the mandible and preventing its disarticulation. A suitable species for this work may be the Herring Gull or some other species of large gull.

The last problem to be considered is the taxonomic value of the medial brace. Unfortunately, the discovery of a new structure (or the detailed study of an already known structure) often leads to the belief that this character has much taxonomic value. A regular cycle has become almost standard for taxonomic characters of first assigning much taxonomic value to newly discovered structures and basing taxonomic systems on them, followed by more and more doubt of their usefulness as they become better known. The final stage is either discarding the character or realizing that it is no better than the hoard of already known taxonomic characters that have gone through the cycle. Such disappointments could be averted if there is not an initial blind faith in the taxonomic usefulness of newly discovered structures. Although the survey of the occurrence of the medial brace in birds is far from complete, it has supplied enough data on which its taxonomic value can be judged.

Three pertinent facts emerge from the survey. They are: (a) Within a given order or family, the medial brace may be present in some forms, but absent in others. (b) The medial brace is not identical in all groups in which it is present; the medial process of the mandible abuts with either the lateral or the medial process of the basitemporal plate, or it may vary in the manner it attaches to one of these processes. (c) A similar medial brace may be present in unrelated groups.

Thus, while a very similar medial brace is present in a number of related families (*e.g.*, Cariamidae, Gruidae and allies; plovers, gulls and allies), an equally similar brace is present in unrelated forms (*Cochlearius*, Sagittariidae, Musophagidae, Charadriinae, Pteroclidae, and Coliidae). The medial brace may appear whenever there is a selection force favoring it, with its exact structure depending, in part, upon the configuration of the basitemporal plate. The latter is partly the result of common origin and partly the result of convergence. Hence, the distribution of the medial brace in birds can provide examples of independent origin, parallelism, and convergence. There have been, at the minimum, 14 independent origins of the medial brace in birds and perhaps even more. The most striking example of convergence is that between the New World and the Old World vultures in which the hind parts of the skull in the larger species in both groups are extremely similar. The medial braces in *Cochlearius*, Sagittariidae, Musophagidae, Pteroclidae, and Coliidae are all similar to that found in

the Charadriinae, yet all of these groups are unrelated, and in the case of *Cochlearius,* the medial brace is not present or only very poorly developed in the other herons from which it had evolved.

It can be concluded that the phylogeny of the medial brace in birds has been very complex and that the task of separating convergence from true affinity is extremely difficult if not impossible at this time. Consequently, little taxonomic value should be assigned to the medial brace of the mandible. This conclusion does not mean that studies of the medial brace will be dull and fruitless. Quite the contrary is true. The structure, function, and evolution of the jaw suspension, including the medial brace, of birds comprise a virtually unknown area of avian anatomy and should provide the student of avian anatomy with many exciting and stimulating problems.

ACKNOWLEDGMENTS

I am indebted to Drs. Ernst Mayr and Ernest Williams who helped in numerous ways throughout the study and who read and criticized the manuscript, to Drs. Gerd von Wahlert and Carl Gans who read parts of the manuscript, to my wife, Kitty, who prepared the histological slides and checked the manuscript for errors, to Dr. A. B. Dawson for his help and advice in interpreting the histological structure of the articulation, and to Dr. Professor Deitrich Starck who confirmed my conclusion that the medial brace was unknown to recent workers and who expressed an active interest in the progress of the study. My sincere thanks are extended to all. Dr. Richard Zusi must be thanked in particular for providing the Shufeldt references and information on the feeding methods of the skimmer. I am most grateful to the officials of the Department of Birds at the American Museum of Natural History for allowing me to examine the skeletal material in their care. This study was done while working under a National Science Foundation Predoctoral Fellowship.

SUMMARY

In many groups of birds, the medial process of the mandible abuts against the basitemporal plate to form a secondary brace of the mandible. This brace may be called the medial brace of the mandible, while its articulation may be called the basitemporal articulation of the mandible. In the plovers *(Charadrius),* the articulation is a syndesmosis. In the skimmer *(Rynchops),* it is a true diarthrosis, but one with dense fibrocartilage articular pads. The medial brace supports the mandible and prevents its disarticulation in compensation for a poorly developed

quadrate hinge. The development of the brace is correlated directly with the strength of the forces on the depressed mandible and inversely with the ability of the quadrate hinge to withstand these forces. The brace is found in a wide diversity of birds, such as the grebes, cormorants, boat-billed heron, vultures, cranes and allies, plovers, gulls and allies, goatsuckers, sand grouse, and mousebirds, but its structure varies. The medial process of the mandible articulates with either the lateral or the medial process of the basitemporal plate, and varies in the manner in which it abuts on these processes. Apparently the exact structure of the medial brace is dependent upon which of these processes of the basitemporal is best developed at the time the mandible makes contact with the base of the skull. Because of this variability in the structure of the medial brace and because of its many independent origins, it is concluded that the medial brace has little value in showing relationships between families and orders of birds. Nevertheless, future study of its function and evolution should constitute one of the most exciting pages in the history of avian anatomy.

POSTSCRIPT

This paper was already in press before I was able to show it to Professor Starck who has kindly offered the following suggestions on the terminology used for the articulations. First, he suggested that the basitemporal articulation be given the proper anatomical name. *i. e.*, according to the bones involved. Thus, the basitemporal articulation would be the articular-basitemporal articulation (or the articular-basipapasphenoid articulation if one uses the terminology for the bones of the skull based on their embryological origins). Second, he pointed out that the classification of articulations which I followed (see footnote, p. 28) is no longer in use. The currently accepted system divides articulations into diarthroses (normal articulations with articular pads, cavity and membrane) and synarthroses (articulations in which there is a continuous intervening substance between the two bones, be it cartilage, fibrous tissue or bone). Synarthroses are divided into synchondroses (in which the intervening substance is cartilage), sutures, and syndesmoses (in which the bones are connected by fibrous tissue). Amphiarthrosis refers to a slightly movable articulation, be it a diarthrosis or a synarthrosis; it alludes only to the functional ability of an articulation and not to its structure. Thus, while the basitemporal articulation of the plover is functionally an amphiarthrosis, it is a synarthrosis and more precisely a syndesmosis.

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PROCEEDINGS OF THE SEVENTY-SEVENTH STATED MEETING OF THE AMERICAN ORNITHOLOGISTS' UNION

H. G. DEIGNAN, SECRETARY

The Seventy-seventh Stated Meeting of The American Ornithologists' Union was held from 25 to 30 August 1959, at the Saskatchewan Museum of Natural History, Regina. Business sessions were held on 25 August, papers sessions on 26, 27, and 28 August, and field trips on 29 and 30 August. Sponsoring organizations were the Saskatchewan Museum of Natural History, the Regina Natural History Society, the Saskatchewan Natural History Society, and Regina College of The University of Saskatchewan.

Business Sessions

On 25 August, the Council met throughout most of the day, the Fellows met late in the afternoon, and the Fellows and Elective Members met together in the evening. The Council held a second meeting in the evening of 27 August.

1960 meeting. The Seventy-eighth Stated Meeting will be held from 23 to 28 August 1960, at Ann Arbor, Michigan, by invitation of The University of Michigan as host organization, and of the Detroit Audubon Society, the Michigan Audubon Society, the Museum of Zoology of The University of Michigan, and The Museum of Michigan State University as sponsoring organizations.

Tentative consideration is being given to Washington, D.C., for the 1961 meeting, and to Salt Lake City, Utah, for the one of 1962.

Awards. The Brewster Memorial Award, by action of the Council, was made to Alexander Wetmore, with the following citation:

> "For the past generation, Dr. Wetmore has been the leading authority on the fossil birds of North America. His scores of papers in this field have in part been summarized in his *Check-list of the Fossil and Prehistoric Birds of North America and the West Indies* (1956), to which we give particular mention.
>
> "Dr. Wetmore's contributions to our science are by no means limited to avian paleontology. The scope of his interests and the magnitude of his efforts are reflected in the books and papers which year after year have set forth the results of his research. Among those of book length are: *Birds of Puerto Rico* (1916); *The Migration of Birds* (1926); *Observations on the Birds of*

Argentina, Paraguay, Uruguay, and Chile (1926); *The Birds of Haiti and the Dominican Republic* (1931—with B. H. Swales); and last, but not least, the fifth edition of the *A. O. U. Check-list of North American Birds* (1957), prepared under his chairmanship.

"In Alexander Wetmore we hail a biologist who, during a career that now spans more than fifty years, has been one of the chief architects of American ornithology."

Marcia Brady Tucker Awards, assisting young ornithologists of promise to attend the annual meeting, were given by vote of the officers to George Alderson, Reed College; Robert H. Barth, Jr., Harvard University; Gerald Collier, University of California, Los Angeles; and Eugene A. LeFebvre, University of Minnesota.

Patrons. The Council voted to inscribe the names of three members permanently in the rolls of the Union as Patrons in recognition of generous contributions to the organization: Louise de Kiriline Lawrence, Margaret Morse Nice, and Arlie William Schorger (the first two through gifts in their honor by Mrs. Herbert E. Carnes).

Membership. The Secretary reported that 2,985 copies of The Auk are being mailed; this mailing list includes all classes of members, subscriptions, and exchanges with other journals. The Treasurer's records showed members by classes, before the elections in this meeting, as follows:

Fellows	77
Fellow Emeritus	1
Honorary Fellows	20
Corresponding Fellows	66
Elective Members	196
Honorary Life Elective Members	5
Honorary Life Members	19
Members	2138
Student Members	39
Total	2561

Charles H. Blake, Chairman of the Membership Committee, reported that the same 25 members, regionally located, as last year served on his committee. He stated that the Treasurer's records indicated that the Union had added or reinstated since last year's Meeting 145 members, and had lost 279 (of whom 182 were "delinquent"), a net loss of

134. He added that the special thanks of the Union were due Dr. C. Stuart Houston, of Yorkton, Saskatchewan, who, while not formally a member of the Committee, had made a special effort to enroll new members in Saskatchewan.

Finances. The report of the Treasurer appears in full elsewhere in The Auk. The Treasurer's records were examined and found in order on 12 August 1959, by T. B. Maxfield, Certified Public Accountant, of Ithaca, New York.

The dues for all dues-paying classes of members were continued at five dollars per year by vote of the Council.

Stephen S. Gregory, Chairman of the Investing Trustees, reported that the appraised value of the endowment holdings, as of 31 July 1959, was $158,699, an appreciation, since 31 July 1958, of $16,400. The net additions during the year were $27,100, of which $4,450 came from earnings.

Gifts to the Josselyn Van Tyne Memorial Fund were made during the year by Mr. and Mrs. Herbert Carnes, Paul H. Hannum, Cyrus Mark, and Mrs. Helen Van Tyne. With these gifts, the Fund now totalled more than $10,000, thus exceeding the point set last year by the Council at which it may be considered operative. While the Union will welcome further donations to the Fund, special solicitation will no longer be necessary.

Editorial matters. The Editor, Eugene Eisenmann, restated that he would not be a candidate for re-election, and acknowledged with thanks the assistance that had been rendered him by members of the Editorial Committee and others. Three numbers of Volume 76 of The Auk have appeared so far in 1959, and the fourth is in press. As was true last year, there is little backlog of manuscript.

The Editor also reported that the "Ten-Year Index to The Auk," covering the years 1941 to 1950, prepared by Charles K. Nichols, is now in galley proof, and he agreed to see it through press, even though his term of office will have expired.

Joseph J. Hickey, Chairman of the *ad-hoc* Committee on Format of The Auk, presented his committee's finished report on publication costs.

The Editor of *The Handbook of North American Birds,* Ralph S. Palmer, reported that the first volume is expected to be ready for the printer at the end of 1959, and that considerable manuscript for the second volume is in his hands.

Reports of committees. W. J. Breckenridge, Chairman of the Committee on Biography, reported that two memorials to Fellows had

been published during the year ending with the July 1959 issue of The Auk, and that three obituaries (one of a Corresponding Fellow, two of Elective Members) are now in the hands of the Editor.

During the year ending July 1959, the Committee had learned of the deaths of three Fellows, two Corresponding Fellows, three Elective Members, one Honorary Life Member, and twenty Members:

Walter F. Allen, Member, 16 August 1958
John H. Arnett, Jr., Member, 7 May 1959
Francis L. Bacon, Member, 1958
Alexander W. Blain, Life Elective Member, 1958
Hiram Bellis Demarest Blauvelt, Life Member, 16 October 1957
Anna P. Bradley, Member, 1959
Charles L. Broley, Elective Member, 5 May 1959
Charles E. Clarke, Member, 22 November 1958
Lionel S. Dear, Member, 22 May 1959
Caroline A. Dunham, Member, 7 January 1959
Pennoyer F. English, Member, 8 October 1958
Edwin T. Goodridge, Member, November 1958
Hatch Graham, Sr., Member, 13 June 1958
Ludlow Griscom, Life Fellow, 28 May 1959
Donald Guthrie, Member, 31 October 1958
P. Auferman Henderson, Member
Lawrence C. Kent, Member, 27 February 1958
Gustav J. Kramer, Corresponding Fellow, 19 April 1959
William H. Lanceley, Member, 20 October 1958
Edward C. Minich, Member, 1959
Robert T. Moore, Life Fellow, 30 October 1958
John T. Nichols, Life Elective Member, 10 November 1958
Edward A. Preble, Fellow Emeritus, 4 October 1957
Mrs. Walter E. Rogers, Member, 4 January 1958
Bruce Fleming Stiles, Member, 17 July 1959
Nobusuke Taka-Tsukasa, Corresponding Fellow, 1 February 1959
Louise K. Town, Member, 1959
Willard G. Van Name, Honorary Life Member, 26 April 1959
Harold Bacon Wood, Member, 1 December 1958

William H. Behle, Chairman of the Committee on Student Memberships, reported by letter that 39 students had been named to receive The Auk free of charge for one year. With one exception, appointed too late for inclusion in the list, the names of the Student Members were published in the April issue of The Auk.

S. Charles Kendeigh, Chairman of the Committee on Research, presented the report of the committee. It appears in full form on pp. 78-79.

Edwin R. Kalmbach, Chairman of the Committee on Bird Protection, presented his report, which appears separately in full on pp. 73-77.

ELECTION OF OFFICERS

At the meeting of Fellows and Elective Members, George H. Lowery, Jr., was elected President, Dean Amadon was advanced automatically to First Vice-president, Austin L. Rand was elected Second Vice-president, Herbert G. Deignan was re-elected Secretary, and Charles G. Sibley was re-elected Treasurer.

Three men were elected to the Council, with terms expiring in 1962: Joseph J. Hickey, Arlie W. Schorger, and Robert W. Storer.

Donald S. Farner was elected Editor of The Auk by action of the Council. The Council also re-elected to the Board of Investing Trustees Stephen S. Gregory, Chairman, and Arlie W. Schorger, and elected Cyrus Mark *vice* Clarence B. Randall, resigned. The complete list of officers and members of the Council appears at the end of the Proceedings.

ELECTION TO SPECIAL CLASSES OF MEMBERSHIP

The following persons were elected to special classes of membership:

FELLOW

John Davis, Carmel Valley, California
A. Starker Leopold, Berkeley, California
Thomas R. Howell, Los Angeles, California

FELLOW EMERITUS

James P. Chapin, New York, New York

CORRESPONDING FELLOW

Derek Goodwin, Great Britain
F. W. Merkel, Germany
F. J. Turček, Czechoslovakia
V. C. Wynne-Edwards, Great Britain

ELECTIVE MEMBER

H. Lewis Batts, Jr., Kalamazoo, Michigan
Pershing B. Hofslund, Duluth, Minnesota
C. Stuart Houston, Yorkton, Saskatchewan
Richard F. Johnston, Lawrence, Kansas
Martin H. Moynihan, Balboa, Canal Zone
Robert K. Selander, Austin, Texas

HONORARY LIFE ELECTIVE MEMBER

William J. Baerg, Fayetteville, Arkansas
Herbert H. Beck, Lancaster, Pennsylvania
Ernest G. Holt, Montgomery, Alabama

ATTENDANCE

Registration at the meeting included 391 persons from seven provinces of Canada, 34 states and the District of Columbia, England, India, and the Republic of the Philippines, as follows:

ENGLAND—James Fisher, Elizabeth Forster.

INDIA—M. A. Badshah.

REPUBLIC OF THE PHILIPPINES—J. B. Alvárez, Jr.

CANADA—*Alberta:* Mr. and Mrs. G. E. Ball, Terence H. Bassett, E. D. Beacham, Martin Boyd, W. A. Fuller, Cedric Hitchon, K. Hodges, Mrs. J. R. Jackson, Laurie Jackson, V. Lewin, Mr. and Mrs. R. Lister, Mr. and Mrs. R. H. Mackay, Mrs. W. S. Ross, Dr. and Mrs. R. W. Turner, Terence Walton. *British Columbia:* Elmer Callin, Anthony J. Erskine, F. A. Gornall, Mr. and Mrs. Theed Pearse, Oliver Wells. *Manitoba:* W. M. Adams, Herman Battersby, Kenneth Black, W. Cartwright, Graham Cooch, David R. M. Hatch, Mr. and Mrs. H. A. Hochbaum, Fanny A. Hollies, Mrs. R. B. Hunter, Mr. and Mrs. A. G. Lawrence, Frank McKinney, Mrs. L. J. McKinney, D. Olson, Mr. and Mrs. A. Shortt, R. I. Smith, Mr. and Mrs. Clarence Tillenius. *New Brunswick:* Robert Squires, Mr. and Mrs. W. A. Squires. *Ontario:* Mr. and Mrs. A. E. Allin, James Baillie, Mr. and Mrs. C. H. D. Clarke, S. Clarke, Mr. and Mrs. K. Denis, K. F. Edwards, Mr. and Mrs. R. Frith, W. Earl Godfrey, William W. H. Gunn, F. M. Helleiner, John Livingston, Mr. and Mrs. Hoyes Lloyd, Harry G. Lumsden, John Lunn, R. McCleary, Mr. and Mrs. G. North, Mr. and Mrs. C. D. Quilliam, Mr. and Mrs. S. Robb, Mr. and Mrs. L. L. Snyder, Mr. and Mrs. J. M. Speirs, George M. Stirrett. *Quebec:* Jonas Spence-Sales.

Saskatchewan: Ethel Abey, Gary Anweiler, Mrs. J. Bailey, W. H. Beck, Mr. and Mrs. K. Beckie, Mr. and Mrs. P. Lawrence Beckie, Margaret Belcher, John Beveridge, T. M. Beveridge, Mr. and Mrs. Dick Bird, J. M. Blemen, J. L. Blizzard, J. D. Boggs, C. Bojuk, Frank Brazier, Mr. and Mrs. R. Bremner, Janice Briggs, E. W. Brooman, Robert Caldwell, Mr. and Mrs. E. M. Callin, Edna Colbeck, Isobell M. Coleman, Mrs. H. A. Croome, Mrs. E. Cruickshank, Brian Davies, Mr. and Mrs. R. Davis, Joyce Dew, Lillian Domes, Alex Dzubin, Dorothy Eley, Lucy Eley, Mr. and Mrs. T. Ellis, Ray Elmore, Robert Folker, Elmer Fox, Glen A. Fox, Reginald Fox, Richard W. Fyfe, Grace Glenn, J. B. Gollop, Justice P. H. Gordon, Pearl Guest, T. Harper, Sylvia Harrison, William Horseman, Dr. and Mrs. C. Stuart Houston, Dr. Harley Jenner, Mr. and Mrs. C. W. Johnston, Mr. and Mrs. O. F. Kaad, Mrs. M. H. Kennedy, Patrick Kennedy, Garth Klatt, R. F. Klatt, Mr. and Mrs. Bruce Knox, Fred W. Lahrman, Mr. and Mrs. G. F. Ledingham, Robert McCall, C. McDonald, R. C. McKenzie, Mr. and Mrs. J. H. McLennan, Mr. and Mrs. R. G. McNamara, Mrs. G. L. Mackenzie, Mr. and Mrs. H. S. Maliepaard, Mr. and Mrs. S. A. Mann, Herbert Moulding, Lucy H. Murray, Gertrude Murray, Bernard A. Nelson, Mr. and Mrs. R. W. Nero, Mr. and Mrs. A. M. Nilson, Lawrence R. Ostoforoff, E. Paynter, Connie Pratt, Marguerite Robertson, V. Rondeau, Frank Roy, Mrs. E. Schua, Spencer G. Sealy, Bruce Shier, Indira Singh, Gordon Staines, M s. N. Steele, T. Sterling, R. Stueck, Melba Stevenson, F. A. Switzer, Mrs. F. B. Taylor, Mrs. H. F. Temple, Mr. and Mrs. J. Walker, Mrs. Jean West, Winnifred Woods, W. Yanchinsky, Constance York.

UNITED STATES—*Alabama:* Robert D. Weigel. *Arizona:* Mr. and Mrs. A. H. Anderson. *Arkansas:* Mrs. Mattie Daugherty, Mr. and Mrs. Douglas James. *California:* Enid K. Austin, Mr. and Mrs. H. L. Cogswell, Gerald Collier, Mary M. Erickson, Earle R. Greene, Thomas R. Howell, Mr. and Mrs. L. M. Huey, L. R. Mewaldt, Mr. and Mrs. Alden H. Miller, Patricia L. Miller, Robert T. Orr, Mr. and Mrs. E. A. Stoner. *Colorado:* A. M. Bailey, Mr. and Mrs. E. R. Kalmbach, Donald Malik, Jack Murphy, Donald M. Thatcher. *Connecticut:* Mr. and Mrs. R. T. Peterson. *District of Columbia:* H. G. Deignan, D. S. Hartman, Mr. and Mrs. F. C. Lincoln, Mr. and Mrs. Alexander Wetmore. *Florida:* Oliver L. Austin, Jr., Pierce Brodkorb, H. Hill Hamon, W. B. Robertson, Jr., W. Shortt. *Georgia:* H. L. Stoddard, Sr., Rex Thomas. *Illinois:* Karl E. Bartel, Frank C. Bellrose, Jr., E. R. Blake, George K. Fisher, Mr. and Mrs. H. I. Fisher, S. S. Gregory, Mr. and Mrs. S. C. Kendeigh, Margaret C. Lehmann, Mr. and Mrs. Carl Nelson, Mrs. L. B. Nice, Mr. and Mrs. A. L. Rand, Paul Shulze, F. A. Swink, Albert Wolfson. *Indiana:* James B. Cope, Robert A. Johnson, Henry C. West, Nixon Wilson. *Iowa:* F. W. Kent, Mrs. P. Petersen, Sr., P. C. Petersen, Jr., Milton N. Weller. *Kansas:* Mr. and Mrs. J. W. Hardy, Mr. and Mrs. R. F. Johnston. *Louisiana:* R. E. Caldwell, Jr., Ethel D. Jones, Douglas A. Lancaster, Electa D. Levi, Mr. and Mrs. George H. Lowery, Jr., Ava R. Tabor. *Maine:* Mr. and Mrs. O. S. Pettingill, Jr., Mr. and Mrs. F. B. Whitman, Jr. *Maryland:* Chandler S. Robbins. *Massachusetts:* R. H. Barth, Jr., Ernst Mayr, Dwight Moore.

Michigan: Mr. and Mrs. H. Lewis Batts, Jr., Mr. and Mrs. R. M. Branch, Denis F. Owen, Robert Payne, John Rood, Mary Spear Ross, Peter Stettenheim, Robert W. Storer, Harrison B. Tordoff, Willet T. Van Velzen, Mr. and Mrs. G. J. Wallace, M. E. Wallace, S. F. Wallace. *Minnesota:* Mr. and Mrs. W. J. Breckenridge, R. W. Dickerman, Mr. and Mrs. F. L. Jaques, Mr. and Mrs. Eugene LeFebvre, Mary Lupient, J. P. Rogers. *Nebraska:* Mr. and Mrs. John Lueshen. *New Jersey:* Mrs. H. E. Carnes, Mrs. J. Y. Dater, Norman B. Pilling, Anne W. Wachenfeld, R. Wilkins, Helen J. Williams. *New York:* Dean Amadon, Mr. and Mrs. W. W. Brockner, Eugene Eisenmann, E. Thomas Gilliard, Mr. and Mrs. L. I. Grinnell, Helen Hays, Lois Hussey, Mr. and Mrs. Harold D. Mitchell, Ralph S. Palmer, Catherine M. Pessino, Mrs. Dayton Stoner, Mr. and Mrs. E. C. Ulrich, Charles F. J. Young. *North Carolina:* Mr. and Mrs. C. H. Blake. *North Dakota:* Dr. and Mrs. R. T. Gammell, Robert H. Gensch, Edmund A. Hibbard. *Ohio:* H. E. Blakeslee, Mrs. Robert V. D. Booth, Vera Carrothers, Mr. and Mrs. F. H. Glenny. *Oklahoma:* Mr. and Mrs. H. C. Land. *Oregon:* George Alderson. *Pennsylvania:* Wilson Baker, Dorothy L. Bordner, Mr. and Mrs. E. R. Bordner, Kenneth C. Parkes, Elizabeth A. Taft, Mr. and Mrs. Lester S. Thomas. *Tennessee:* Albert F. Ganier. *Texas:* Elizabeth Blount, L. Irby Davis, Allan Hayse, Louise Teagarden Hill, Margaret Louise Hill, Pauline James, Robert K. Selander, Edith R. Wilson, L. R. Wolfe. *Utah:* James R. King. *Virginia:* John W. Aldrich. *Washington:* Donald S. Farner. *West Virginia:* Mr. and Mrs. Maurice G. Brooks, George A. Hall. *Wisconsin:* James Brush, R. L. Dana, Mr. and Mrs. Cleveland Grant, Owen J. Gromme, Mr. and Mrs. F. N. Hamerstrom, Jr., J. J. Hickey, Chester G. Krawczyk, R. A. McCabe, Earl N. McCue, William McPeek, Jack Orgeman, O. Rongstad, Mr. and Mrs. A. W. Schorger, Mr. and Mrs. W. E. Scott, Marvin E. Vore.

PUBLIC SESSIONS

Papers sessions were held in the morning and afternoon of each of the three days beginning Wednesday, 26 August, in the auditorium of the Saskatchewan Museum of Natural History.

WEDNESDAY MORNING SESSION

The meeting was opened by an address of welcome by E. Manley Callin, President, Saskatchewan Natural History Society. Ernst Mayr, President of The American Ornithologists' Union, responded. The Secretary, Herbert G. Deignan, summarized the results of the previous day's business sessions, including elections and awards.

E. THOMAS GILLIARD, American Museum of Natural History, New York, *Report from New Britain* (slides).

STUART HOUSTON, Yorkton, Saskatchewan, *Thomas Drummond, Forgotten Ornithologist* (slides).

PIERCE BRODKORB, University of Florida, Gainesville, Florida, *How Many Kinds of Birds Were There?*

OLIN SEWALL PETTINGILL, JR., University of Michigan, Biological Station, Pellston, Michigan, *King Eiders Breeding with Common Eiders in Iceland* (slides).

HAROLD D. MITCHELL, Buffalo Ornithological Society, Buffalo, New York, *A Nesting Involving Prothonotary and Yellow Warblers* (motion pictures and slides).

WEDNESDAY AFTERNOON SESSION

DONALD S. FARNER, State College of Washington, Pullman, and D. L. SERVENTY, Commonwealth Scientific and Industrial Research Organization, Nedlands, Western Australia, *Body Temperature and the Ontogeny of Thermoregulation in the Slender-billed Shearwater* (slides).

THOMAS R. HOWELL, University of California, Los Angeles, California, *Temperatures inside the Air Sacs of Birds* (slides).

A. W. SCHORGER, University of Wisconsin, Madison, *Crushing of* Hicoria *Nuts in the Gizzard of the Turkey* (slides).

JAMES R. KING, University of Utah, Salt Lake City, Utah, L. RICHARD MEWALDT, San Jose State College, San Jose, California, DONALD S. FARNER, State College of Washington, Pullman, Washington, *The Duration of Postnuptial Metabolic Refractoriness in the White-crowned Sparrow* (slides).

ALDEN H. MILLER, University of California, Berkeley, California, *Response to Environmental Light Increments by Andean Sparrows from an Equatorial Area.*

ALBERT WOLFSON and DAVID P. WINCHESTER, Northwestern University, Evanston, Illinois, *Effect of Photoperiod on the Gonadal and Molt Cycles of a Tropical Bird,* Quelea quelea (slides).

S. CHARLES KENDEIGH, University of Illinois, Champaign, Illinois, *Annual Stimulus for Spring Migration* (slides).

L. RICHARD MEWALDT, San Jose State College, San Jose, California, *Orientation of Migratory Restlessness in the White-crowned Sparrow* (slides).

THURSDAY MORNING SESSION

RALPH S. PALMER, New York State Museum, Albany, New York, *Reproductive Pattern of the Loons.*

ROBERT W. STORER, University of Michigan Museum of Zoology, Ann Arbor, Michigan, *The Discovery Ceremony of the Horned Grebe* (motion pictures and slides).

ALEX DZUBIN, Canadian Wildlife Service, Saskatoon, Saskatchewan, *Aerial Displays and Flights of the Mallard* (slides).

HELEN HAYS, Cornell University, Ithaca, New York, *Motivations of some of the Displays of the Ruddy Duck* (slides).

ROBERT W. NERO, Saskatchewan Museum of Natural History, Regina, *Comparative Behavior of the Red-winged Blackbird and the Yellow-headed Blackbird* (motion picture).

GERALD COLLIER, University of California, Los Angeles, California, *Breeding Behavior in the Tricolored Blackbird and some Aspects of Competition with the Red-winged Blackbird* (tape recorder and slides).

ROBERT K. SELANDER and DONALD R. GILLER, The University of Texas, Austin, Texas, *A Biosystematic Analysis of Sympatry of Boat-tailed and Great-tailed Grackles* (Cassidix) *in the Gulf Coast Region of Texas and Louisiana* (tape recorder and slides).

THURSDAY AFTERNOON SESSION

Symposium on Waterfowl

H. ALBERT HOCHBAUM, Moderator,
Delta Waterfowl Research Station, Delta, Manitoba.

1. FRANK BELLROSE, State Natural History Survey, Havana, Illinois, *Mallard Homing on Flyway Routes* (slides).

2. F. G. COOCH, Canadian Wildlife Service, Winnipeg, Manitoba, *Ecological Aspects of the Blue-Snow Goose Complex* (slides).
3. MILTON W. WELLER, Iowa State College, Ames, *Parasite Egg-laying in the Redhead* (slides).
4. FRANK MCKINNEY, Delta Waterfowl Research Station, Delta, Manitoba, *The Analysis of Duck Displays* (motion picture).

FRIDAY MORNING SESSION

OLIVER L. AUSTIN, JR., Florida State Museum, Gainesville, Florida, *The Terns of the Dry Tortugas* (slides).

CHANDLER S. ROBBINS, Patuxent Research Refuge, Laurel, Maryland, and DONALD D. STAMM, U. S. Public Health Service, Montgomery, Alabama, *Mist Netting as an Aid in Bird Population Studies* (slides).

GEORGE J. WALLACE, Department of Zoology, Michigan State University, East Lansing, Michigan, *Further Comments on Robin Losses on a University Campus.*

HOWARD L. COGSWELL, Department of Biological Sciences, Mills College, Oakland, California, *Territory Size and Substrate for Foraging in the Wrentit and Rufous-sided Towhee* (slides).

DOUGLAS JAMES, Department of Zoology, University of Arkansas, Fayetteville, Arkansas, *The Effect of Winter Weather on the Abundance of Birds* (slides).

S. DILLON RIPLEY, Peabody Museum of Natural History, Yale University, New Haven, Connecticut, *Aggressive Neglect as a Factor in Interspecific Competition in Birds* (slides).

R. H. BARTH, JR., Biological Laboratories, Harvard University, Cambridge, Massachusetts, *Studies on Mixed Species Flocks with Special Reference to the Formicariidae* (slides).

CHARLES J. LARUE and ROBERT K. SELANDER, Department of Zoology, The University of Texas, Austin, Texas, *An Apparent Interspecific Appeasement Display of the Brown-headed Cowbird* (Molothrus ater) (motion picture).

FRIDAY AFTERNOON SESSION

PETER STETTENHEIM, USDA Regional Poultry Research Laboratory, East Lansing, Michigan, *The Development of Plumage in Young Leghorn Chickens* (slides).

CHARLES H. BLAKE, Hillsboro, North Carolina, *Attainment of Definitive Plumage in White-throated Sparrows, a Preliminary Report* (slides).

KENNETH C. PARKES, Carnegie Museum, Pittsburgh, Pennsylvania, and PHILIP S. HUMPHREY, Peabody Museum of Natural History, Yale University, New Haven, Connecticut, *Apparent Departures from Typical Sequences of Plumages and Molts* (slides).

LAWRENCE I. GRINNELL, Laboratory of Ornithology, Cornell University, Ithaca, New York, *Birds of Southeastern Australia* (motion picture).

JACK A. MURPHY, Denver Museum of Natural History, Denver, Colorado, *Nesting of the Sooty Albatrosses in Subantarctic New Zealand* (motion picture and slides).

ALFRED M. BAILEY, Denver Museum of Natural History, Denver, Colorado, *The Haunts of the Royal Albatross* (motion picture).

SOCIAL EVENTS

A luncheon for the Council and a dinner for Fellows and members of the Council were held at the Hotel Saskatchewan on 25 August; in the evening a reception and film program, sponsored by the Museum, were held for those not attending the business session.

On the afternoon of 26 August, wives of members and other guests were taken on a tour to Fort Qu'Appelle, and that evening an exhibition of Canadian bird art and bird photography was opened at the Norman Mackenzie Art Gallery, Regina College, followed by a reception.

Wives of members and other guests were given a tour of Regina City on the afternoon of 27 August. The evening was devoted to a picnic supper in Wascana Park, followed by a program of films in the auditorium of the Museum.

A cocktail party, followed by the Annual Banquet, both sponsored by the Government of Saskatchewan, took place on the evening of Friday, 28 August, in the Wa-Wa Shrine Temple, with the Honorable T. C. Douglas, Premier of Saskatchewan, acting as host. The Union had not before in its history been officially entertained by a Provincial or State Government.

FIELD TRIPS

Before-breakfast excursions to nearby areas were made on the mornings of 26, 27, and 28 August. On Saturday, 29 August, an all-day trip was made by bus to the northern end of Last Mountain Lake; the highlight of the day was the spectacle of some 8,000 sandhill cranes at rest and in flight. On Sunday, a briefer excursion was made to various prairie lakes and sloughs less distant from Regina.

RESOLUTIONS

The following resolutions were submitted by the Resolutions Committee (Maurice Brooks, Chairman; Alfred M. Bailey; and Walter J. Breckenridge) and approved by the General Session on 27 August 1959:

1. *Resolved,* that the American Ornithologists' Union, holding its 77th Stated Meeting in Regina, Saskatchewan, commends the Wheat Province and the Queen City for its vision in providing for all people so fine a facility as the Saskatchewan Museum of Natural History.

2. *Resolved,* that the American Ornithologists' Union meeting at Regina, highly commends the Government of Guatemala for its action in protecting all waterfowl on Lake Atitlán especially since the Giant Pied-billed Grebe *(Podilymbus gigas)* occurs nowhere else. The continued existence of this unique species is thereby assured and opportunity to study its behavior and its interaction with other species on the lake is made more feasible.

The Government is further commended for its efficient and informative posting of the lake shore.

The American Ornithologists' Union further congratulates the Government of Guatemala on taking the lead in Central America in protecting not only a rare and noteworthy species but also an aquatic habitat attractive to visitors.

The American Ornithologists' Union requests its Secretary to communicate this action to:

Dr. Jorge A. Ibarra, Director,
Museo Nacional de Historia Natural
Ciudad Guatemala, Guatemala,

for conveyance to the appropriate officials of the government.

3. *Resolved,* that the American Ornithologists' Union, here assembled in Regina, expresses its grateful appreciation to the sponsoring organizations: Regina College of the University of Saskatchewan, Saskatchewan Natural History Society, Regina Natural History Society, and the Saskatchewan Museum of Natural History of the Department of Natural Resources, and the Museum director, Fred G. Bard, and to Robert W. Nero, Chairman of the Local Committee on Arrangements, and his efficient and hard-working committee members: Mrs. Marjorie Ledingham, Elmer Fox, Margaret Belcher, Frank Brazier, Joyce Dew, Richard Fyfe, Peter Gregg, Mrs. Jean Hodges, Bruce Knox, Fred W. Lahrman, George F. Ledingham, Max McConnell, James Millington, Gertrude Murray and Bruce Shier.

The American Ornithologists' Union wishes also to thank all the many persons who have made possible the field trips, arts and photography exhibits, tours and other special events which have so hospitably accompanied the 77th Stated Meeting.

4. The American Ornithologists' Union expresses its hearty thanks to the Province of Saskatchewan, its Premier, the Hon. T. C. Douglas, and the other officials of its government who have so graciously honored the Union and its guests at officially-sponsored social events.

The Union takes note of the fact that it has not before in its history been received and entertained officially by a Provincial or State Government, and it requests its Secretary to convey the thanks of the Union to the appropriate officials.

OFFICERS AND TRUSTEES OF THE AMERICAN ORNITHOLOGISTS' UNION

	Expiration of Term
George H. Lowery, Jr., *President*	1960
Dean Amadon, *First Vice-President*	1960
Austin L. Rand, *Second Vice-President*	1960
Herbert G. Deignan, *Secretary*	1960
Charles G. Sibley, *Treasurer*	1960
Donald S. Farner, *Editor of The Auk*	1960

ELECTIVE MEMBERS OF THE COUNCIL

Eugene Eisenmann	1960
John T. Emlen, Jr.	1960
Olin Sewall Pettingill, Jr.	1960
Oliver L. Austin, Jr.	1961
Harold F. Mayfield	1961
L. L. Snyder	1961
Joseph J. Hickey	1962
Arlie W. Schorger	1962
Robert W. Storer	1962
Robert T. Orr, Cooper Ornithological Society Representative	1960
H. Lewis Batts, Jr. Wilson Ornithological Society Representative	1960

EX-PRESIDENTS

James P. Chapin, 1939-42
Herbert Friedmann, 1937-39
Hoyes Lloyd, 1945-48
Ernst Mayr, 1957-59
Alden H. Miller, 1953-56
Robert Cushman Murphy, 1948-50
Alexander Wetmore, 1926-29

INVESTING TRUSTEES

Stephen S. Gregory	1960
Cyrus Mark	1960
Arlie W. Schorger	1960

TREASURER'S REPORT FOR THE PERIOD AUGUST 1, 1958—JULY 31, 1959

Income to Active Fund Account

Dues	$10,115.24
Subscriptions	1,754.25
Sale of back issues of The Auk	285.56
Royalties on microfilms of The Auk	2.26
Royalties on sales of Recent Studies	104.75
Miscellaneous sales	75.60
Advertising	313.75
Donations to Active Publication Fund	119.50
Income from:	
General Endowment Fund	2,726.36
Ruthven Deane Fund	273.32
Interest — Savings Account 1958-59	320.88
Balance in Active Account, 1958	2,491.13
Total Income, 1959	$18,582.60

Special Funds

Brewster Memorial Fund		
Income from investments	$ 442.27	
Cost of Medals		$ 45.04
Transferred to Endowment Fund as instructed by Dr. Schorger		397.23
	$ 442.27	$ 442.27
Bird Protection Endowment Fund		
Balance forward	$ 73.05	
Income from investments	56.12	
Donation to International Committee for Bird Conservation		$ 25.00
Donation to International Union for the Protection of Nature and Natural Resources — 1958		50.00
Donation to International Wildfowl Research Bureau		25.00
Donation to International Union for the Protection of Nature and Natural Resources — 1959		50.00
Balance overdrawn	20.83	
	$ 150.00	$ 150.00

Educational Endowment Fund		
Balance forward	$ 193.79	
Income from investments	226.63	
To William H. Behle		$ 9.48
39 Student Members		195.00
Balance in Account		215.94
	$ 420.42	$ 420.42
Special Publication Fund		
Balance forward	$13,566.57	
Received from sale of Check-lists and Recent Studies	2,357.45	
Postage		$ 50.98
Transferred to Handbook Fund		500.00
To Investing Trustees		8,100.00
Balance in Account		7,273.04
	$15,924.02	$15,924.02
XIII International Ornithological Congress		
Transferred from 1959 Dues Account	$ 500.00	
Supplies (Stationery)		$ 137.50
Balance in Account		362.50
	$ 500.00	$ 500.00
Endowment Fund		
Balance in uninvested funds, 1958	$ 497.71	
Transferred from Brewster Fund	397.23	
Life Membership payments	3,846.00	
Patron payments	902.77	
From the Estate of Ethel A. Dwight	6,250.00	
Donations	138.50	
Sale of Audubon prints	100.00	
To Investing Trustees		$11,700.00
Balance in Account		432.21
	$12,132.21	$12,132.21
Handbook of North American Birds Fund		
Balance forward	$ 3,447.43	
Transferred from Special Publication Fund	500.00	
Donation	100.00	
Supplies		17.95
Balance in Account		4,029.48
	$ 4,047.43	$ 4,047.43

Marcia B. Tucker Fund		
Balance forward	$ 1.86	
Donation for 1959 awards	500.00	
George Alderson		$ 90.00
Robert H. Barth, Jr.		150.00
Gerald Collier		220.00
Eugene A. LeFebvre		40.00
Balance in Account		1.86
	$ 501.86	$ 501.86
Van Tyne Memorial Fund		
Balance forward	$ 5,699.40	
Received for investment	1,641.00	
To Investing Trustees		$ 7,300.00
Balance in Account		40.40
	$ 7,340.40	$ 7,340.40
National Science Foundation Grant		
Balance forward	$ 2,800.00	
Transportation and Expenses		$ 2,062.60
Refund of balance to NSF		737.40
	$ 2,800.00	$ 2,800.00

DISBURSEMENTS

Manufacture and distribution of The Auk	$12,465.97
Reprints from The Auk for AOU	28.97
Editor's expense	881.65
Secretary's expense — Balance of year 1957-58, $144.91 and year 1958-59	744.91
Salary — Treasurer's Assistant — Balance of year 1957-58 and year 1958-59	1,400.00
Mailing of back issues and other publications	10.85
Addressing machine and other addressing expense	441.10
Stationery, labels, etc.	178.85
Telephone and telegraph	11.23
Cost of Dues Notices and postage	438.65
Postage	322.26
Affiliation Fee — A.I.B.S., 1959	100.00
Donation — Zoological Society of London	50.00
Donation — International Committee on Zoological Nomenclature	10.00
Annual Meeting	362.01
TOTAL EXPENDED, 1959	$17,446.45

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Balance in Active Account, 1959	$ 1,136.15
Balance in Bird Protection Endowment Fund	(20.83)
Balance in Educational Endowment Fund	215.94
Balance in Special Publication Fund	7,273.04
Balance in Endowment Fund	432.21
Balance in Handbook Fund	4,029.48
Balance in Tucker Fund	1.86
Balance in Van Tyne Fund	40.40
Balance in XIII International Ornithological Congress Fund	362.50
	$13,470.75

Savings Account — First National Bank, Ithaca, N. Y.	$11,291.37
Checking Account — First National Bank, Ithaca, N. Y.	2,179.38
	$13,470.75

CHARLES G. SIBLEY, *Treasurer*

REPORT TO THE AMERICAN ORNITHOLOGISTS' UNION BY THE COMMITTEE ON BIRD PROTECTION, 1959

With respect to bird protection, internationally speaking, your Committee is fortunate in having as one of its members the President Emeritus of the International Council for Bird Preservation, Jean Delacour, who, regretfully, was unable to attend this meeting. He has, however, given us a digest of matters that have come to his attention. I know you will be interested in the fact that the Council published, in 1959, its Bulletin VII which presents accounts of its activities concerning, among other subjects, birds in danger of extinction, establishment of refuges, prevention of oil pollution of the sea, further protection of birds of prey, wildfowl preservation, and the effects of pesticides on wildlife. It contains articles on the state of bird protection in more than 20 countries with information on the laws in force. This Bulletin may be obtained for $2.30, including postage, from Mr. G. W. Merck, New York Zoological Society, 30 East 40th Street, New York 16, N. Y.

During 1958 and 1959 the I.C.B.P. has been particularly active in efforts to prevent the mass destruction of small birds in Italy, used in special dishes in restaurants for tourists, including, no doubt, patrons from North America. The Executive Board of the International Wildfowl Research Bureau (a branch of the I.C.B.P.) met in the south of Spain in April 1959. Among other matters a resolution was sent to various German authorities requesting complete protection for *Branta bernicla* in the German Federal Republic for three years as has been done in other European countries.

A most successful International Conference on Oil Pollution of the Sea was held in Copenhagen, Denmark on 3–4 July 1959. This meeting was well attended by representatives of a wide range of interests including government departments of transport and commerce, ship owners, port authorities, seamen's unions, sea fishery associations, conservation, ornithological and humanitarian organizations, together with the diplomatic representatives of 19 nations. In addition, delegates from seven international organizations concerned with conservation of varied natural resources were in attendance. This Conference was called by the British Coordinating Advisory Committee on Oil Pollution of the Sea. Considerable help in obtaining support was given by the President of the I.C.B.P., Dr. S. Dillon Ripley, and the Chairmen of the National Sections of Canada, The German Federal Republic, The Netherlands, Norway, Poland and Sweden. It was announced that an intergovernmental committee had unanimously adopted a draft report (for submission to the Secretary of State) that

the United States accept the 1954 Convention with reservations of a technical nature.

In this connection, it should be mentioned that, until foreign ship operators become thoroughly aware of regulations regarding the discharge of oil in inland North American waters, ships now using the St. Lawrence Seaway may create increased hazards to bird life in the Great Lakes.

The International Council for Bird Preservation continues to extend its membership, the latest countries to form National Sections being Portugal and Malaya. The next world meeting of the Council will be held in Japan in 1960, when it is hoped to arouse further interest in bird conservation in Asia.

Word comes from Dr. Ibarra of the National Museum of Natural History in Guatemala that recently enacted legislation has afforded complete protection to aquatic bird life at Lake Atitlán. The fact that this area is increasingly important as a tourist attraction has led to this commendable action.

Help in the form of documents useful in the promotion of refuges in East Africa was rendered to the Director of the Coryndon Museum in Nairobi. It is gratifying to know that a beginning has been made to provide sanctuaries for birdlife in that colony.

That mushrooming of the human race is having dire effect on wildlife in the latest of our states, Hawaii, comes from the President of the Hawaii Audubon Society, Mr. Joseph E. King. While he did not favor the attempt, made by the Board of Commissioners of Agriculture and Forestry, to introduce the Barn Owl from California, ostensibly to aid in the control of rodents, he was more concerned with the rapid development of the island of Oahu and its threat to native birds, particularly aquatic species inhabiting the lowlands. The Hawaiian Gallinule and the Hawaiian Stilt, he states, are examples, and, with the continued drainage of ponds and marsh areas, migratory waterfowl will be deprived of wintering areas in the Hawaiian Islands. Nevertheless, a gratifying note comes from Hawaii with the report that seven nests of the Nene Goose had been found, some of them in rough lava beds many yards distant from vegetative cover.

A matter of more than ordinary importance to those concerned with the management of troublesome birds was the holding of a one-day conference on bird control on 18 August 1959, in the Department of the Interior in Washington, D.C.

The morning session dealt with damage to agricultural crops, the research that is being done to alleviate it, and the policies of the Fish and Wildlife Service in meeting these problems. The afternoon session

concerned albatrosses as hazards to aviation at airports in the Mid-Pacific. Our President was unable to attend so the chairman of your Committee was asked for comments which were transmitted by mail. Without going into details, it may be said that promotion of bird control, particularly that of a reductional nature, was emphatically condemned. As a matter of policy it was urged that the function of the federal government in matters of bird damage be, first, to determine the nature and extent of the damage, second, the devising of measures for alleviating the damage with emphasis on procedures of avoidance and prevention rather than reductional control, and, third, the promulgation of these methods so that those directly involved might take steps to protect themselves. The idea of promotion of operational bird control, either through federal or cooperative funds was opposed. Up to the time of preparing this report your chairman has had no information regarding any decisions made at this conference.

Progressive legislation in the protection of birds of prey was enacted in several states. New Jersey, Maryland, and New Hampshire, in the East, and Minnesota and Oklahoma in the Midwest, afforded protection to hawks and owls, usually with a proviso that the birds may be killed when actually inflicting damage.

With respect to the dispersal of highly toxic pesticides about which all of us are concerned, we must realize that we are dealing, not only with contemplated programs, but with accomplished facts. I refer, in particular, to control measures against the fire ant in the Southeast and the Dutch elm disease in more northern areas. We have no means at our disposal summarily to stop or materially reduce the intensity of these going programs. Our hope must lie in the findings that, we feel, will come from the research now started. Recently received from the Bureau of Sport Fisheries and Wildlife is a statement that its Branch of Research has a current annual budget of $185,000 for studies of the effect of pesticides on wildlife and an additional $95,000 allocated for sport and commercial fishery work in the same field. Legislation proposed in bills in the Senate and the House would raise the authorization for future research of this kind to $2,565,000 annually. Actual appropriations, however, would be made in accordance with the needs of a rationally expanding program as the work proceeded. Please remember that this two and one-half million to cover research in all aspects of pesticide use is about the same as that being appropriated annually for operational fire ant control alone, with no appreciable research having antedated its inception.

Progress in the research on pesticides was reported at the hearings before the House Committee on Marine Fisheries on August 4 and the

Senate Committee on Foreign and Interstate Commerce to increase appropriations for pesticide research (Senate Bill 1575; House Resolution 5813). A transcript of this testimony was not available to your Committee at the time this report was being prepared.

To recite all the accumulating evidence of the harmful effects of aerial dispersal of highly toxic pesticides would extend this report far beyond a permitted length. It may be advisable, however, to call attention to certain facts that are characteristic of extensive, governmentally sponsored pest control operations. As pointed out by a careful observer of the fire ant program in the Southeast, the average landowner seldom objects as long as the federal or state government is footing the bill. The "gravy train" is always popular; never protested by the recipient of its benefits. When such programs are buttressed also by a wealth of supporting propaganda from sources long looked upon as authentic, few indeed are those who will question it. Often the very individuals engaged in such promotion are the ones whom, through years of personal contact, the farmer has learned to trust. Is it little wonder, then, that the fire ant and other similar projects acquire and retain support?

Because of the increasing magnitude of chemical pest control your chairman ventures the suggestion that, in the United States, legislation, comparable in principle to that of the Coordination Act in water manipulation matters, be enacted to help regulate the dispersal of pesticides under governmental projects. You will recall that the Coordination Act calls for advisory council from wildlife agencies in connection with governmentally sponsored water manipulation projects. At the rate we are going, one can readily see that dispersal of highly toxic materials over great areas may be as disastrous to wildlife as the ill-advised manipulation of a water supply in a single stream or impoundment.

Here in Regina many of us are closer to the nesting of the Whooping Crane than we have ever been before. Yet, we are still some 700-odd miles south-southeast of the nearest nest location. This Museum has served as a clearing house for whooping crane information for the two governments concerned with the preservation of this noble bird. We can expect Director Bard and his associates to give us up-to-the-minute information sometime during this meeting. Nevertheless, a few notes from the South will introduce the subject. During the 1959 nesting season the captive pair at the New Orleans Zoo laid seven eggs, the first on 14 February and the last on 8 May. For reasons not yet known to this Committee none of these hatched. That means that the captive population remains the same—three adults and three juveniles. The

23 adults and 9 young that wintered in 1958–1959 on the Arkansas Refuge, plus the 6 in captivity, brought the known total, in the spring of 1959 to 38, the highest recorded at any time during the past 21 years.

As mentioned in last year's report, the status of the Greater Prairie Chicken is a matter of utmost concern to ornithologists. In Illinois, Wisconsin, and elsewhere in the Midwest it is looked upon as the number-one bird conservation problem. Its solution (if at all possible) will rest on the acquisition and maintenance of sufficient grassland habitat. The Soil Bank program has aided some, but there is question regarding its permanency for this long-time project.

You are all familiar with the adverse conditions that confronted waterfowl in the southern parts of the Prairie Provinces this year. Even at a late date the decline in water levels continues in Saskatchewan, and the apparent maintence of waterfowl populations in the adjacent provinces may be due to an influx of birds from the drouth-ridden province of Saskatchewan. In line with sound management, hunting privileges have been curtailed both in Canada and the United States.

It has been learned that the federal government of Canada will call a national conservation conference sometime in 1960. Up for discussion will be all the problems of resource conservation and it is expected that the needs of a positive wildlife program will receive attention.

It is impossible in a report of this kind to discuss all the problems that arise in the field of bird conservation. There just isn't time enough at one of these meetings nor pages enough in The Auk to comment on everything that logically might be considered. Therefore, your Committee asks your indulgence if your greatest concern or pet peeve has been passed over lightly or wholly ignored. Let us hope (even though it seems futile) that the time may come when the problems of bird protection will be so few, or so inconsequential, that the whole subject could be treated in a few pages of typewriting.

Jean Delacour
Ira N. Gabrielson
Robert A. McCabe
David A. Munro
E. R. Kalmbach, *Chairman*

REPORT OF THE RESEARCH COMMITTEE FOR 1959

Four items of special interest are here considered. A preliminary statement was made concerning each item to the A.O.U. Council at the Regina meeting, and the following report embodies the discussion that ensued.

1. The duties of the Research Committee are to foster and encourage ornithological research. In this connection the Committee wishes to be of more active service in assisting isolated investigators or those planning research in new fields to get acquainted with existing knowledge and methodology. Members of the A.O.U. are urged to communicate with the Committee whenever help is needed or when they have suggestions to offer on current problems. In order for this mutual interchange of ideas to develop, the Council agreed to the publication of the annual reports of the Committee in The Auk, subject to the approval of the editor.

2. The suggestion that the Committee collect and dispense information on unpublished Ph.D. theses and on research in progress has been studied, but no action is contemplated at the present time. Attention is called to *Dissertation Abstracts,* published by University Microfilms, Ann Arbor, Michigan. This is a monthly publication that contains condensed summaries of completed Ph.D. theses that have been microfilmed and titles of theses that have been accepted for the degree but not microfilmed. A large and increasing number of our leading universities are participating in this service, and copies of the publication are available in their libraries.

3. There is a strong feeling among many bird workers that abstracting of ornithological papers, recently published, is inefficient, scattered, and unorganized. There is considerable duplication of effort with abstracts of the same papers being prepared by different persons and published in separate journals such as The Auk, Bird-Banding, Wildlife Review, Biological Abstracts, Zoological Record (titles only), as well as various foreign periodicals. Each journal emphasizes certain aspects to the exclusion of others.

There would be many advantages for the serious researcher to have complete coverage of current literature centralized in one publication. This would facilitate locating material, avoid wasteful duplication of effort, and would free additional pages in the various journals for publishing original papers. For instance, the 1958 volume of The Auk contained 40 pages of "Recent Literature." This space, if available, would have permitted publishing four more leading articles of the length that was average for this volume. A large number of the articles abstracted were from the Wilson Bulletin, Condor, Journal of

Wildlife Management, etc., that many of The Auk readers have already read in the original, and it is doubtful if more than a small percentage of the remaining abstracts are not duplicated elsewhere.

On the other hand, "Recent Literature" is undoubtedly of interest to some readers, especially those who do not regularly subscribe to other journals with abstracting services. To them, this section is an important asset of The Auk.

Opinion was definitely divided among those participating in the discussion at Regina concerning the desirability of limiting all abstracting to one central agency, with the possible elimination of the section of "Recent Literature" from The Auk. The Research Committee was encouraged to look into the matter further. *We would be glad to have an expression of opinion from A.O.U. members generally.* In this connection it should be kept clearly in mind that the section on "Reviews" is not in question. Reviews of books and important articles, where there is critical evaluation of subject matter, are very valuable, and such evaluations by several persons are very desirable.

4. The Committee has no enthusiasm for preparing another volume of "Recent Advances in Avian Biology," such as was published in 1955. As an alternative the committee recommends publication in The Auk of individual review papers covering special fields and of symposia centering around some special theme in which several specialists would contribute shorter papers. The Council gave general consent to this proposal, subject to approval of the editor of The Auk.

Topics that have been suggested for such reviews and symposia are: avian genetics, molt patterns, diurnal migration, limitation of population size, energy requirements, evolution of behavior patterns, endocrinology, comparative developmental rates of young, marine ecology, biochemical criteria for taxonomy, and niche analysis. Doubtlessly other suitable topics will occur to our readers. The committee invites correspondence on this proposal, especially from persons who may be interested in participating.

Andrew J. Berger
John Emlen (in absentia)
Donald S. Farner
Ralph S. Palmer
Harrison B. Tordoff
Milton B. Trautman
M. D. F. Udvardy
S. C. Kendeigh, *Chairman,*
Vivarium Bldg., University of Illinois,
Wright and Healey Sts.,
Champaign, Illinois

GENERAL NOTES

Bachman's Sparrow Hiding in a Burrow.—On 22 October 1944, the day following a hurricane, the vicinity of Orlando, Florida, was being checked for any unusual birds by a group including Drs. George M. Sutton, B. F. McCamey, Marshall W. Nirenberg, and the author. In a pineland area east of Orlando a sparrow was flushed but disappeared almost immediately into a small relatively isolated clump of saw palmetto *(Serenoa serrulata)*. In order to obtain a more certain identification, an unsuccessful attempt was made to flush the bird again. When examined more closely, the palmetto clump was found to hide the entrance to a burrow of the gopher tortoise *(Gopherus polyphemus)*. At first no sign of the sparrow could be discovered. However, Dr. Sutton thought he had glimpsed the bird just at the limit of visibility in the burrow, so we enlarged the hole (originally perhaps slightly less than a foot in transverse diameter) enough to allow a better search. As the work progressed, Dr. Sutton suddenly sighted and grasped the bird at a depth of approximately 3½ to 4 feet from the mouth and 2 feet below the surface of the ground. It proved to be a Bachman's (Pine Woods) Sparrow *(Aimophila aestivalis aestivalis)* and was released after identification. Although it is famous for its shyness, to my knowledge this is the first record of a bird of this species taking refuge in such a place.—JAMES A. PITTMAN, JR., *University of Alabama Medical Center, Birmingham, Alabama.*

Mutation in an African Flycatcher, *Dyaphorophyia concreta*.—The Yellow-bellied Wattle-eye, *Dyaphorophyia concreta*, is widespread, although nowhere common, in the forested regions of tropical Africa. It is local in distribution, particularly in areas where the forests are broken up, and consequently has subdivided into numerous races. The basic pattern of all forms, however, is the same. The upper parts, sexes alike, are uniform, varying from olive-gray to a metallic green or blue-gray, with upper tail coverts and tail dark metallic green. The underparts are yellow, but in the females the throat and breast are washed with chestnut, which extends onto the belly and flanks in some forms. The characters used in the discrimination of subspecies are the color and luster of the upperparts, and the extent and intensity of the chestnut wash in the females. Consequently, females have been more useful than males in separating subspecies, and several races including *ansorgei* Hartert of Angola (see *note* at end) have females as types.

D. c. ansorgei was originally known only from a single female from Cabeca de Ladroes in Benguela. A second female was collected at Roca Congulu in the rain-forest region of Gabela by Rudolf Braun (Sick, 1934: 170), and in 1954-55 Gerd Heinrich collected six males and two females from Gabela and Canzele for Chicago Natural History Museum. More recently an expedition of the British Museum collected four males and four females, virtual topotypes of *ansorgei*, from Chingoroi. The known range of *ansorgei* in Angola, therefore, is at three isolated localities in evergreen forest: Canzele, Gabela, and Cabeca de Ladroes, separated in each case by over 150 miles. This isolation, however, may be more apparent than real. Suitable habitat exists in the region Ndala Tando-Dondo and possibly in small pockets of evergreen forest along the escarpment.

Normally colored males have been taken at all three localities. They are typical of the race in being gray washed with olive-green above. The underparts are a uniform, deep-rich yellow, and a male from Canzele and one from Gabela have even a light chestnut wash on the breast and belly. Three other males from Gabela, however, have a striking mutant character not found elsewhere in the

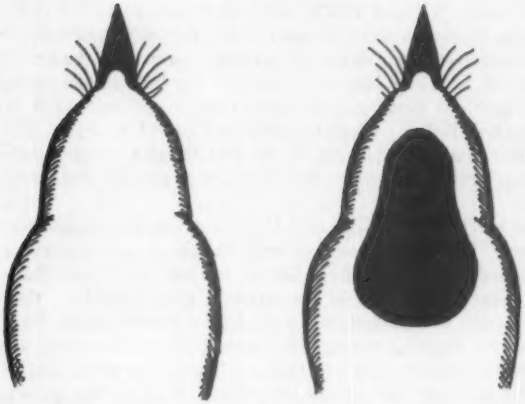

Figure 1. Ventral view of normal (left) and mutant (right) *Dyaphorophyia concreta ansorgei*. The black breast patch is approximately 15 × 30 mm.

species, a sharply defined, black oval patch on throat and breast (see Fig. 1). This patch varies from 26 to 30 mm. long by 15 mm. wide, and the black is glossed with bluish-green. Between these three mutants and three normally colored males from Gabela there is no other discernible difference in plumage, proportions, or size. Five of the Gabela males are adults in breeding condition, and there is no possibility of an immature plumage being involved. Meise (1958: 76) has described the nestling and the first-year plumages of males from Canzele, and there is no suggestion of a black patch in either. This mutation has evidently become well established in the region around Gabela, since three of six males possess it. It is not known to occur elsewhere in Angola or in other races of the species, but the evidence is of course negative, and based on few specimens. On the same negative evidence it does not occur in the females, and as there are now nine females known from Angola, the chances are that it will not be found to occur.

In many cases where a mutant character appears in a population, it is possible to find similar characters within the genus or family; that is, there is a potential within the group to produce a certain character. However, I know of no other species within the Muscicapidae that has a similar type of mark. I have had the opportunity to show these specimens to Professor Erwin Stresemann and Dr. J. Chapin, and both agree that they know of no other examples like it. This black breast patch appears to be unique within the family.

I would like to thank Mrs. B. P. Hall of the British Museum for the loan of her specimens and for her notes on the ecology of the region of Angola where she collected in 1957.

Taxonomic note. Dyaphorophyia concreta ansorgei differs from *D. c. harterti* of Cameroon and Gabon in being olive-gray above instead of a glossed blue-gray; males are a richer yellow below, sometimes washed with chestnut, and females have the chestnut paler and confined to the breast with no wash on the flanks—not

the reverse as stated by Bates (1926: 105). It is a well-marked race, and previously all Angola specimens were included in it. Recently, however, Meise *(l. c.)* has divided *ansorgei* into two races, the nominate form from the type locality and Gabela, and a new form *canzelae* from Canzele. He had only an adult female and one immature and one nestling male from Canzele and one adult female from Roca Congulu (near Gabela) which he considered typical *ansorgei*. The characters of *canzelae*, based on a comparison of the two females, were: darker; crown, sides of the head and neck grayer, less olive-green tinted; chestnut breast wash not so intense.

Through the kindness of Mrs. Hall I have been able to examine two males and two females, near topotypes of *ansorgei*, from Chingoroi, and to compare them with our five males and two females from Gabela and one male from Canzele. In the color of the upper parts there is no variation geographically; the male from Canzele is no darker nor grayer on the head than the two males from Chingoroi. There is individual variation among the Gabela males, and one has a bluish gloss similar to *harterti* of Cameroon and Gabon. There is a great deal of individual variation in the presence and amount of chestnut wash on the underparts of the males, but the extremes are two males from Gabela, with the Canzele bird being intermediate with only a slight wash. The females are uniform in the color of the upperparts; the intensity of the chestnut on the breast, however, varies widely between the two birds from Gabela, and this is not a character of taxonomic significance. On the basis of this material, it is not possible to recognize *canzelae* as distinct from *ansorgei*.

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—Melvin A. Traylor, *Chicago Natural History Museum, Chicago, Illinois.*

First Specimens of Sooty Shearwater for Delaware.—On 5 June 1959, Klaus Kallman, Josh Wallman, and the writer found two dead Sooty Shearwaters, *Puffinus griseus*, on the shore near Bethany Beach, Delaware, about two miles north of the Maryland state line. When found both birds were in good condition, and the silvery wing linings were noted, but only the heads were saved. These were deposited in the American Museum of Natural History, New York, where identification was confirmed by Dr. R. C. Murphy.

J. H. Buckalew (Auk, 67: 251, 1950) knew of only two records from the Del-Mar-Va Peninsula, but gave locality and date only for one found on 21 June 1940 at Chincoteague, Virginia. He *(in litt.)* advises that on 13 July 1932 he picked up a dead Sooty Shearwater north of Rehoboth Beach, Delaware, near the site of the old Cape Henlopen lighthouse, but that the specimen was too badly decomposed to preserve and therefore was not reported in the literature. A supposed Maryland record is not credited by Stewart and Robbins (Birds of Maryland and the District of Columbia, 1958) p. 388.—Peter W. Post, *575 West 183d St., New York 33, N. Y.*

Semipalmated Sandpiper and Western Sandpiper in Tamaulipas.—There being very few definite records of the Semipalmated Sandpiper *(Ereunetes pusillus)* for Mexico (see Friedmann, Griscom, Moore, Pacific Coast Avif., 29: 99, 1950, and Thompson, Wilson Bull., 70: 288, 1958), it seems advisable to call attention to an adult female specimen (bill 19.5 mm.) collected 31 July 1953, by R. R. Graber at Laguna Blanca, 11 miles southeast of Norias, on the Tamaulipas coast. The specimen (RRG 2419), which is now housed with my collection, appears to be largely in winter feather, the only obvious remnants of the breeding plumage being a few worn, blackish-brown scapulars and a scattering of dark, much-worn chest feathers.

The Western Sandpiper *(E. mauri)*, which apparently has never been reported from Tamaulipas (see Friedmann, *et al., op. cit.*), probably migrates regularly along the east coast of Mexico along with the Semipalmated Sandpiper. There are seven Tamaulipas specimens in my collection, all obtained by Helmuth O. Wagner, at Pesca, on January 14 (female) and 16 (four males, two females), 1948. The specimens are in full winter feather. The January 14 female (HOW 2135), whose culmen measures 30.0 mm., is the longest-billed Western Sandpiper I have ever handled. In the two January 16 females (HOW 2157, 2161) the culmen measures, respectively, 27.0 and 21.5. I thought for a time that the short-billed bird was a Semipalmated Sandpiper, but it is too slender billed and a little too pale throughout the upper parts for that species. There is a possibility that the specimen was incorrectly sexed, though Dr. Wagner's label-drawing clearly shows an organ about 1 mm. wide and 2.5 mm. long. The January 16 males (HOW 2159, 2160, 2162, 2163) have a bill length of 24.0, 23.0, 22.0, and 23.5, respectively.—George Miksch Sutton, *Department of Zoology, University of Oklahoma, Norman, Oklahoma.*

Color of the Tarsi and Toes of the Black Rail.—Examination of two fresh specimens of the Black Rail *(Laterallus jamaicensis)* has prompted us to call attention to the color of the tarsi and toes of this species, since our observations do not agree with published accounts. Audubon (Ornithological Biography, vol. IV; 361, 1838) and Friedmann (Birds of North and Middle America, U.S. Nat'l. Mus. Bull., 50: 154, 1941) state that the tarsi and toes are bright yellowish-green. Descriptions in other publications are similar. Prominent bird artists, including Fuertes, have depicted the color of these appendages as yellowish-green, yellow, or green; while Allan Brooks' illustration of this species (The Book of Birds, vol. I, National Geographic Society, p. 291, 1932) shows pink legs.

An adult female specimen was collected by J. A. Hagar, C. S. Robbins, and R. E. Stewart near Elliott Island, Maryland, on 8 June 1958. A second adult Black Rail, presumed to be a female by its dull color and call, was caught alive by the authors in the same area on 17 June 1958, and is still held in captivity. The tarsi and toes of these two birds show no trace of yellow or green. They appear grayish, matching "Flint" (plate 56—1C) or "Gunmetal" (plate 48—2C) in Maerz and Paul's "A Dictionary of Color" (1930), and "blackish-brown" in the color charts provided with Palmer and Reilly's "A Concise Color Standard" (Am. Ornith. Union Handbook Fund, 1956). A grayed-off blackish-brown would seem to be an appropriate description.

Other supporting evidence was obtained concerning this matter. An adult male specimen in the U.S. National Museum, collected near Chincoteague, Virginia, on

12 June 1958, by C. O. Handley, Jr., was found to have tarsi and toes that were identical in color to those of the two females. Herbert L. Stoddard of Thomasville, Georgia, in recent correspondence reports that he has examined the tarsi and toes of four freshly killed male Black Rails, and that "all had legs practically the same color as those of the King and Virginia Rails; a dull chocolate blackish."

The existence of this discrepancy between the actual coloration of legs and toes of Black Rails recently examined, and the descriptions of these parts in the literature, was verified by Dr. Herbert Friedmann and Mr. Herbert G. Deignan of the U.S. National Museum, and Dr. John W. Aldrich and Mr. Thomas D. Burleigh of the U.S. Fish and Wildlife Service. Possibly, these recorded differences could be related to age or race. However, we are not aware of any concrete evidence that would support such a supposition.—Brooke Meanley and Robert E. Stewart, *Patuxent Research Refuge, Laurel, Maryland.*

The Basis of Color Dilution in an Albinistic Blue Jay.—In March 1955, an albinistic Blue Jay *(Cyanocitta cristata)* was collected near Milford, New York, by Mr. Chester Sweet. The bird was with a flock of jays when collected and appeared to be normal except for coloration.

Color was evident only in areas corresponding to those of heaviest pigmentation in the normal bird. Thus the hard parts, neck band, and parts of the wings and tail were the only parts of the aberrant bird that were at all strongly colored. The bill, feet, legs, the area around the eye, and the neck band, which are all black on normal jays, were brown on the light-colored one. Areas which are normally light-colored, such as the breast and throat, are even lighter on the aberrant one. The top of the head and the back, normally gray-blue or dusky blue, are dirty white in the albinistic specimen. The portions of the primaries, secondaries, and tail feathers, normally blue and black, are in the present specimen respectively very light blue and light brown.

The blue color of the Blue Jay is due to scattering of light through a modified layer of transparent cells in the barbs (the so-called box cells) containing gas-filled vacuoles, which lie above cells containing a brown melanin pigment (see Gower, 1936, and Frank, 1939). The question was whether the unusual coloration in this specimen was due to a deficiency of pigment, or to a structural abnormality in the blue-producing cells. Ten micron cross sections were made of the barbs in order to determine the cause. Basically the process of Gower (1936) was used, but the feathers were not bleached. They were imbedded in paraffin, then mounted in Canada balsam. Corresponding secondary wing feathers were selected because of their range of color. The sections showed the pigment to be greatly reduced in the feathers of the light-colored bird, as compared with the normal (Fig. 1). Although seen in only one feather, it was assumed that this difference would hold throughout the bird. No structural difference could be detected, but the box cell layer was very indistinct in both birds, the vacuoles not being visible at 970×.

According to the classification proposed by Pearson, Nettleship, and Usher (1911-1913), and used by Mueller and Hutt (1941), this bird is an imperfect albino, as there is a partial inhibition of pigment formation in the feathers. I have been unable to find other records of imperfect albinism in the Blue Jay or other blue birds.

Acknowledgments. The author is indebted to Dr. L. D. Uhler for help in preparation of material, and to Dr. C. G. Sibley for suggestions.

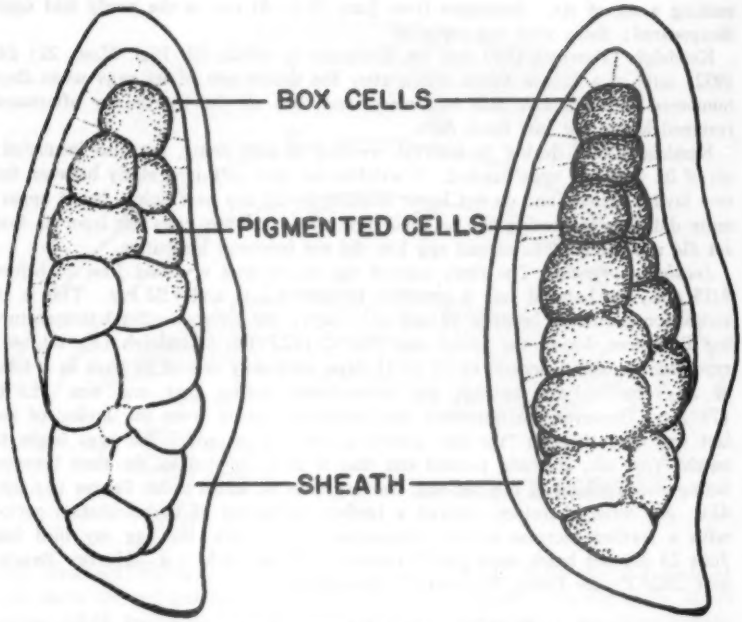

Figure 1. Cross sections of barbs of Blue Jay feathers, comparing the imperfect albino (left), with the normal. Drawings were made at 970×.

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—JOHN WHITAKER, *Department of Conservation, Cornell University, Ithaca, N. Y.*

Egg Replacement by a House Wren: Incubation Period.—In Baltimore in 1959 a House Wren *(Troglodytes aëdon)* began laying eggs in my nest box on June 13. On June 16, when there were four, all disappeared. Nevertheless, new eggs appeared on the next two days, so that on June 18 the bird completed what would have been a set of six. Then on June 23, laying was resumed through June 26, the four new eggs, along with the two remaining from the first laying, again

making a set of six. Sometime from June 28 to 30 two of the newly laid eggs disappeared; these were not replaced.

Kendeigh (Parental Care and Its Evolution in Birds, Ill. Biol. Mon., 22: 24, 1952) tells of a House Wren which after the destruction of its eggs when they numbered four likewise laid two more, and then on the fourth day afterward resumed laying for just three days.

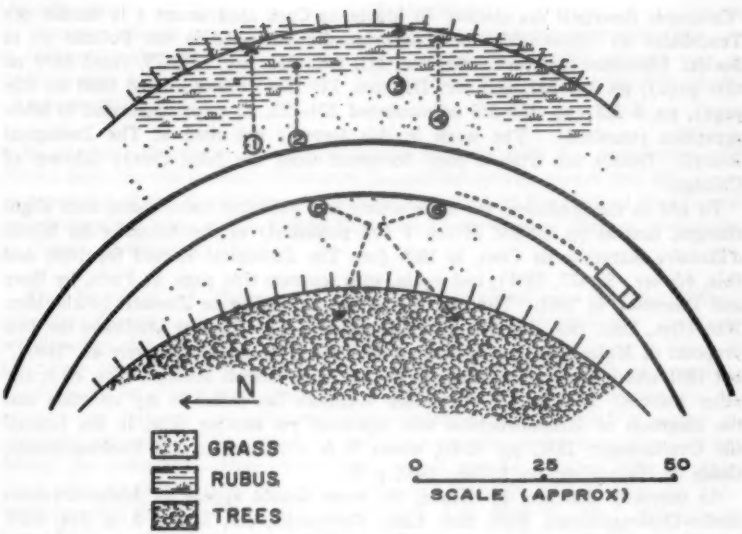
Kendeigh's bird during its interval reverted to nest lining, but also incubated; all of its final five eggs hatched. I watched my bird only irregularly between the two laying periods and do not know whether it did any nest lining, but it apparently did little incubating and on some days none; the two eggs left from its first set did not hatch. The second egg loss did not interrupt incubation.

Incubation period. The final, marked egg in my nest was laid June 26 before 5:15 A.M., and hatched July 8 sometime between 6 A.M. and 4:55 P.M. This is an incubation period of between 12 and 12½ days; the average official temperature for Baltimore during the period was 28.2°C (82.7°F). Kendeigh (*op. cit.*, 44) reported incubation periods of 12 to 15 days, with only one of 12 days in a total of 33 records; the average air temperature during that one was 25.6°C (78°F). However, he measured the incubation period from the laying of the last egg only through "the day preceding the one on which the eggs begin to hatch" (*op. cit.*, 26) and pointed out that if it is counted as the time between laying and hatching of the last egg, one day must be added to his figures (*op. cit.*, 43). My wren, therefore, showed a further shortening of the incubation period with a further increase in air temperature. Curiously, the egg my bird laid June 23 did not hatch until July 9 between 1:43 and 4:54 P.M.—HERVEY BRACKBILL, *2620 Poplar Drive, Baltimore 7, Maryland.*

Communal Courtship in the Ruffed Grouse, *Bonasa umbellus* L.—Accounts of groups of Ruffed Grouse observed during the mating season are rather rare. In fact, Bump *et al.* (1947, "The Ruffed Grouse," The Holling Press, Inc., Buffalo, p. 260) noted that "During April and May, on the other hand, out of 1327 birds [flushed], only one such group was encountered, this being four birds in April." The following observation of six grouse, three of which were in courtship display, was made 16 April 1959, near Stepp's Gap, on the south slope of Mount Mitchell, North Carolina, at an elevation of 6,000 feet.

At about 6:15 P.M., while traveling south on North Carolina Highway 128, 0.1 mile south of Stepp's Gap, I noticed a Ruffed Grouse (#1), *Bonasa umbellus*, on the east shoulder of the road. During early spring, single grouse are frequently seen feeding in the new grass along this highway and the Blue Ridge Parkway, so I thought little of its presence until I noticed a second bird (#2), with tail spread, wings dragging, and ruff erected, a few feet farther on. As the car slowed down, two other grouse (#3 and #4) became evident on the east side of the road. With the passing of my car, grouse #1, #3, and #4 ran into a thicket of blackberries (*Rubus* sp.) bordering the grassy shoulder, and disappeared. Grouse #2, however, sedately strutted toward, and into, this thicket, but was still visible and displaying at the termination of this observation.

After stopping the car 50-60 feet from the group of birds, my attention was turned to the west road shoulder, a steep, rocky cut. Here two grouse, both "strutting," were advancing toward each other. As they drew nearer, they changed to the "intimidation display" of Knight (1947, "Ruffed Grouse," Alfred A. Knopf, New York, p. 25), advancing in short dashes, head low to the ground,



with occasional flurries of ruff shaking. Upon closing to about two feet distance, both birds stopped and faced each other for a few seconds, whereupon the uphill grouse (#5) folded his ruff and tail and slowly withdrew up the mountainside. Grouse #6 made no move to pursue his foe, but returned a few steps down the cut, still displaying, and withdrew by a different route. The period of observation lasted about two or three minutes. Although I believe that grouse #2 and #6 were males, and that #5 may have been, no individual bird was watched sufficiently to determine the sex.—David A. Adams, *Chief Park Naturalist, North Carolina Division of State Parks, Raleigh, North Carolina.*

Errors Concerning the Date and Source of the Name *Melanotrochilus* Eudes-Deslongchamps (Trochilidae).—In the earlier nomenclators and in major reviews of the hummingbirds, including the latest standard checklist (Peters, J. L., Check-list of Birds of the World, 5: 22, 1945), the subgeneric (or generic) name *Melanotrochilus* Deslongchamps (Eugene Deslongchamps, surname more properly rendered Eudes-Deslongchamps; *cf.* Catalogue of the Library of the British Museum of Natural History, 2: 547, 1904, and other standard bibliographic sources) is cited from the Guide du Naturaliste, 2: 7, 1880. In that volume, according to Otto Taschenberg (Bibliotheca Zoologica II, 5: 4342, 1899), pp. 7–9 are devoted to an article entitled "Étude sur le groupe des Jacobines (Oiseaux-Mouches) et le nouveau sous-genre Melanotrochilus" (see also The Zoological Record for 1880).

However, as already correctly indicated by S. A. Neave (Nomenclator Zoologicus, 3: 90, 1940), the name was actually published earlier by the same author, in 1879. A diagnosis of the genus and a full account of its single species, *Melanotrochilus fuscus* (*Trochilus fuscus* Vieillot, Nouv. Dict. Hist. Nat., 7: 348, 1817; Brazil), appear on pp. 314–316 of the first of two parts of Eudes-Deslongchamps'

"Catalogue descriptif des oiseaux du Musée de Caen appartenant à la famille des Trochilidés ou Oiseaux-Mouches" as originally published in the Bulletin de la Société Linnéenne de Normandie, ser. III, tom. III (for 1878–79, dated 1879 on title page), pp. 149–321, and ser. III, tom. IV (for 1879–80, dated 1880 on title page), pp. 8–325 (pp. 324–325 misnumbered 224–225, an error undetected in bibliographies consulted). The work in this form is not cited in The Zoological Record. Details are from a copy borrowed from the John Crerar Library of Chicago.

To add to the confusion, the same article was published twice more, with slight changes, first as pp. 59–534 of vol. I (all published) of the Annuaire du Musée d'Histoire Naturelle de Caen, in 1880 (see The Zoological Record for 1880, and Ibis, 4th ser., 5: 477, 1881), and again, with separate title page, at Paris, by Savy and Desrolles, in 1881. The text of the last, according to Zimmer (Field Mus. Nat. Hist., Zool. Ser., 16: 210, 1926), is paged 1–489. Zimmer attributed the first proposal of *Melanotrochilus* to that version, which he dated tentatively as "1880?," but 1881 was given by Taschenberg *(loc. cit.)*, the British Museum *(loc. cit.)*, and other sources. Finally, Dr. Alexander Wetmore has called to my attention that the diagnosis of *Melanotrochilus* was reprinted yet another time, in the Journal für Ornithologie, 1881, pp. 85-86, where it is attributed to "E. Deslongchamps, Guide de Naturaliste, no. 1, Jan., 1880, p. 8."

As correctly indicated by Neave, the name should appear as *Melanotrochilus* Eudes-Deslongchamps, Bull. Soc. Linn. Normandie, ser. 3, vol. 3, p. 314, 1879. Statement of this fact in the ornithological literature may help to avert further error.—Robert M. Mengel, *Museum of Natural History, University of Kansas, Lawrence, Kansas.*

The Skeleton and Systematic Position of *Gampsonyx*.—The little Neotropical hawk *Gampsonyx swainsonii* was placed with the kites in the family Accipitridae until Peters (Check-list of Birds of the World, 1: 281, 1931) and later Hellmayr and Conover (Field Mus. Nat. Hist., Zool. Ser., 13: pt. 1, no. 4, 288, 1949) transferred it to the Falconidae.

Recently Plotnik (Revista Invest. Agricolas, 10: 313, 1956) pointed out that the external morphology of *Gampsonyx* resembles that of the kites, and Vesta Stresemann (Auk, 76: 360, 1959) reported that it has the accipitrid type of wing molt.

Thanks to the kindness of John Hamlet, of Birds of Prey, Ocala, Florida, and Dr. Charles H. Wharton, of Georgia State College, Atlanta, I have been able to study a skeleton of *Gampsonyx swainsonii leonae* from Barranquilla, Colombia.

The principal skeletal differences between the Acciptridae and the Falconidae are as follows (Cf. Friedmann, Bull. U.S. Nat. Mus., no. 50, pt. 11, p. 62, 1950; Brodkorb, in Blair, *et al.*, Vertebrates of the United States, pp. 415, 426, 1957; Brodkorb, Bull. Florida State Mus., vol. 4, p. 274, 1959):

Accipitridae:	Falcondidae:
1. Lacrimals free, with double superciliary plate;	1. Lacrimals fused to frontals, without superciliary plate.
2. Palate indirectly desmognathous, with vomer not expanded;	2. Directly desmognathous, with vomer expanded to meet maxillo-palatines.
3. Mandible without foramen;	3. Mandibular foramen present.
4. Thoracic vertebrae free;	4. Thoracics ankylosed.

Accipitridae:	Falcondidae:
5. Sternum without internal spine;	5. Spina sterni interna present.
6. Coracoid with procoracoid perforate;	6. Procoracoid perforate or not.
7. Tibiotarus with 2 openings under supratendinal bridge;	7. Supratendinal bridge with 3 openings.

In all these characters *Gampsonyx* agrees perfectly with the Accipitridae and differs from the Falconidae. Therefore the skeletal system proves that this genus is a member of the Accipitridae, as already suggested on the basis of its external morphology and wing molt.—Pierce Brodkorb, *Department of Biology, University of Florida, Gainesville, Florida.*

The Duration of Postnuptial Metabolic Refractoriness in the White-crowned Sparrow.—It is well known that gonadal activation and simulated premigratory fat deposition can be experimentally induced in many species of migratory passerines by treatment with long daily photoperiods. These responses are followed by a period of insensitivity during which the gonads regress, the fat deposits are depleted, and additional photostimulation will not elicit a second or additional response. This *refractory period* occurs also under natural conditions during the postnuptial phase, lasting for several months (Miller, 1948, J. Exp. Zool., 109: 1; 1954, Condor, 56: 13; Farner and Mewaldt, 1955, Condor, 57: 112; Wolfson, 1958, J. Exp. Zool., 139: 349; Shank, Auk, 1959, 76: 44). The refractory period is accordingly not merely a laboratory artifact, although it can be detected only by experimental means. For the sake of clarity, we will distinguish between *gonadal* refractoriness and *metabolic* refractoriness, the latter designating the insensitivity of the fat-deposition mechanisms to artificial photostimulation.

It has been shown that gonadal refractoriness involves insensitivity of the hypothalamo-hypophyseal system to photostimulation (Miller, 1949, Science, 109: 546; Benoit, Assenmacher, and Walter, 1950, Comptes Rendus Soc. Biol., 144: 573). Because of the physiological similarity and apparent temporal coincidence of the gonadal and metabolic refractory periods, it has been generally assumed that they share a common functional basis. Recently, however, Shank (1959, Auk, 76: 44) has presented data which suggest that metabolic refractoriness in the White-throated Sparrow *(Zonotrichia albicollis)* lasts considerably longer than gonadal refractoriness. It thus appears that there may be quantitative differences between these types of refractoriness which might provide an experimental wedge for exploring the basis of the phenomena. It is our purpose in this note to present data which strongly support the suggestion advanced by Shank.

Figure 1 shows the variation in mean body weight of groups of White-crowned Sparrows *(Zonotrichia leucophrys gambelii)* which were exposed to artificially prolonged daily photoperiods beginning on the dates shown in the figure. These birds were captured near Pullman, Washington, during the autumn migration and were caged out-of-doors, exposed to natural photoperiods, until the beginning of the experimental treatment. On the successive dates indicated, each group was transferred to an indoor isolation room and exposed to a 15-hour daily photoperiod. The group transferred on 3 December was exceptional in that the birds were exposed to 20 hours of light per day. We do not regard this disparity in photoperiod as significant in the interpretation of the results. Unpublished data from our laboratories agree with those of Winn (1950, doctoral dissertation, Northwestern University) that daily photoperiods in excess of about 14 hours are

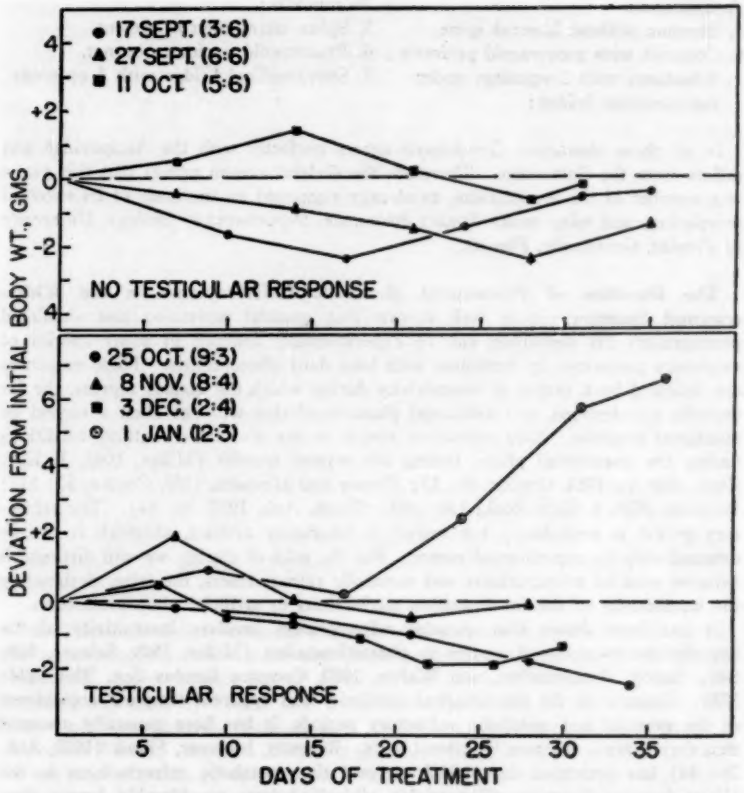


Figure 1. Variation of body weight in groups of White-crowned Sparrows exposed to artificial photoperiods (see text). *Upper panel:* groups in which no testicular growth was detected. *Lower panel:* groups in which definite testicular growth was detected. In both panels the dates indicate the first day of experimental treatment. The numbers in parentheses indicate the composition of the groups in terms of males:females.

essentially supramaximal stimuli for the body-weight response. In all other respects the experimental groups were maintained under uniform conditions. Some of the data have been published previously as initial and terminal averages (Farner and Mewaldt, 1955, Condor, 57: 112), but it appears justifiable to analyze these more fully and to augment them in the present connection. The experimental conditions, including the criteria for testicular activation, are described in detail in the earlier publication.

The upper panel in Figure 1 illustrates the variation in body weight in groups of White-crowned Sparrows in which the males showed no testicular growth

above the level of controls maintained out-of-doors on natural photoperiods. There was no detectable difference in the body-weight patterns of the sexes, and they have accordingly been averaged together. The body-weight patterns of the experimental groups in which the males did exhibit significant gonadal enlargement are shown in the lower panel of Figure 1. Testicular response was obtained in one-third of the males of the group started on 25 October, and in all of the males of the experimental groups started on or after 8 November, indicating that testicular refractoriness was dissipating during late October and early November. Consistent body-weight response, however, did not occur until January, although one male of the group transferred on 3 December exhibited typical "premigratory" fat deposition. It is therefore clear that the mechanisms engendering fat deposition remain unresponsive to photostimulation until sometime in December, or fully a month longer than the testicular response mechanism. The data of Shank extend to an experimental group of White-throated Sparrows transferred to 20-hour daily photoperiods on 16 December, in which there was a testicular response, but no fat deposition. For the Junco *(Junco hyemalis)*, Shank's data suggest that the termination of testicular and metabolic refractoriness was essentially coincident. There may, therefore, be phyletic differences in the duration of the refractory periods.

Although it would be unwise to extrapolate extensively from these limited data, their major significance lies in the fact that they suggest that the gonadotrophic and metabolic control functions of the avian hypothalamo-hypophyseal system in relation to migration may be basically independent of one another, although they temporally overlap in their effects and may be influenced by the same environmental stimuli. This point of view is supported by the existence of vernal gonadal growth *without* concomitant fattening in nonmigratory passerines (e.g., *Zonotrichia leucophrys nuttalli*, which in part shares winter range with *Z. l. gambelii*). Although evidence is accumulating which advises caution in reasoning from mammalian data to avian function (*e.g.*, Newcomer, 1959, Endocrinology, 65: 133), there appears to be ample reason to suspect, on the basis of mammalian experiments, that the conspicuous lipogenesis and high turnover rate of depot fat which characterizes the migratory period in birds may be regulated to an important extent by the hypophyseal-adrenal axis (see Levin and Farber, 1952, Recent Prog. Hormone Res., 7: 399; Wool and Goldstein, 1953, Amer. J. Physiol., 175: 303; Zarafonetis *et al.*, 1957, Amer. J. Med. Sci., 243: 493; Levy and Ramey, 1959, Endocrinology, 64: 586). The potentially important role of the adrenal cortex in avian migration has received almost no experimental attention, however, and we can only speculate as to the significance of the adrenal steroids.

In conclusion, it appears that the significance of metabolic refractoriness in the annual cycle of wild birds is an open question. It is clear that the postnuptial refractoriness of the photosensitive response mechanism does not inhibit the deposition of migratory fat in the autumn. In captive *Z. l. gambelii*, autumn fattening attains nearly the magnitude of the vernal phase, although the rate of development is usually slower and there is much greater individual variation as to timing and rate. This observation conforms with the hypothesis that the *induction* of autumnal adiposity depends upon a different mechanism than the vernal phase (Schildmacher and Steubing, 1952, Biol. Zentralbl., 71: 272; Rautenberg, 1953, Wiss. Zeits. Univ. Greifswald, Math.-naturwiss. Reihe, 2: 229), but does not necessarily imply that the endocrine and energetic aspects of the fattening are different. On the contrary, unpublished data from our laboratories indicate that autumnal fattening in *Z. l.*

gambelii is accompanied by a pronounced hyperphagia (excessive energy intake as a result of appetite stimulation), as has been previously demonstrated during vernal fattening in this species (King and Farner, 1956, Proc. Soc. Exp. Biol. Med., 93: 354). The data of Rautenberg (1957, J. Ornith., 98: 36) and Merkel (1958, Zeits. vergleich. Physiol., 41: 154) also can be interpreted in the same way.—JAMES R. KING, *Department of Experimental Biology, University of Utah;* L. RICHARD MEWALDT, *Department of Biological Sciences, San Jose State College;* and DONALD S. FARNER, *Department of Zoology, Washington State University.*

Nesting of Louisiana Waterthrush and White-throated Sparrow in Eastern Coastal Massachusetts.—Although both the Louisiana Waterthrush *(Seiurus motacilla)* and the White-throated Sparrow *(Zonotrichia albicollis)* have long been known to breed in western Massachusetts and have been repeatedly observed in summer in the eastern coastal area, Griscom and Snyder (Birds of Massachusetts, 1955) knew of no breeding record from that area. Breeding of both species was established in 1959 in Milton, Massachusetts, near Boston.

The Louisiana Waterthrush has been observed in late May and June at Milton and Boxford for the past 12 years. On 15 May 1959, the senior author found a nest in a heavily wooded valley in the Blue Hills, Milton, five feet above a shallow pool that connected with a clear, rapid brook 10 feet away. The nest was near the top of the upturned roots of a fallen maple tree, and was partly concealed by clods of earth hanging from the roots. When found the nest contained one egg; when next visited on 20 May, the female was sitting on three eggs. The incubating bird was flushed from three eggs on 22, 25, 28, and 30 May. On 1 June, the nest held one egg and two just-hatched young. On 12 June, the three well-grown young (the white superciliary clearly visible) were still in the nest at 10:00 A.M.; they were gone by 5:00 P.M. The young had thus flown 12 days after two eggs hatched, and 28 days after the first egg was found. The junior author heard the male singing on 3 May, but during the incubation period song was noted only on 18 May.

A White-throated Sparrow (a male in breeding plumage) was noted by the junior author and Miss Dana Mills on 10 June 1957, in a nursery of young pines and spruces near Great Blue Hill, Milton, carrying food, as if to young. White-throated Sparrows were observed at the same locality in the summer of 1958, but no nest was found at that time. On 1 June 1959, the senior author found what was apparently the 1958 nest. On 15 June 1959, in the same locality, the senior author and his wife, after a careful search, discovered under a small pine a nest containing three young. On 20 June, when the nest was next visited, the young had left.—HENRY S. FORBES, *71 Forest St., Milton 86, Massachusetts, and* JANE D. O'REGAN, *23 Crockett Avenue, Dorchester 24, Massachusetts.*

A Substitute Name for *Crypturellus strigulosus peruvianus*.—In a recent paper on Peruvian game birds (Fieldiana: Zoology, 1959, 39: 373), I described a new race of tinamou, *Crypturellus strigulosus peruvianus*, from Departamento Madre de Dios. My designation of the trivial name proves to be most unfortunate since preoccupied by *Crypturus tataupa peruviana* Cory, 1915. I therefore propose as a substitute: *Crypturellus strigulosus tambopatae*, nom. nov.—EMMET R. BLAKE, *Chicago Natural History Museum, Chicago, Illinois.*

Thick-billed Kingbird Nesting in New Mexico.—Prior to 1958, the Thick-billed Kingbird *(Tyrannus crassirostris pompalis)* was not known to occur in the

United States. In June of that year, Seymour H. Levy discovered two birds of this species in Guadalupe Cañon in extreme southeastern Arizona (Auk, 76: 92, 1959). Although he found no nest, the female kingbird which he collected contained an egg and undoubtedly was nesting nearby. Mr. Levy also located another pair of these kingbirds, with an active nest, in that part of the cañon which lies in adjacent Sonora, Mexico. Johnston and Hardy (Condor, 61: 208) reported seeing *Tyrannus crassirostris* in Guadalupe Cañon in the summer of 1958, but they cited no specific locality or date.

Between 19 June and 6 July 1959, I observed two pairs of Thick-billed Kingbirds in that part of Guadalupe Cañon which lies in southwestern Hidalgo County, New Mexico. On 20 June, one pair began constructing a nest approximately 65 feet above ground in a large sycamore *(Platanus wrightii)* 1.5 miles from the Arizona-New Mexico state line. This pair was still present, and one bird apparently incubating, on 28 June. On the same day, I located the completed nest of a second pair one-half mile to the northeast. This nest also was in a sycamore and at least 50 feet above ground. The two birds frequently exchanged places on the nest and undoubtedly were incubating. I collected the male of this pair. Its testes measured 6 x 17 mm., and a large incubation patch was present.

During the same period, I observed three pairs of Thick-billed Kingbirds in the Arizona portion of the cañon. On 20 June one of these began building a nest 25 feet above a dry stream bed in a sycamore. I did not search for nests of the other pairs.

The three nests which I observed were thin and frail, unlike the compact, well-built nests of most other North American species of *Tyrannus*. (Nests of *T. dominicensis*, the species most closely resembling *crassirostris*, are reported to be frail and loosely woven.) They appeared to be constructed largely of slender twigs and grass stems, the ends of which projected outward and upward from the rims, imparting a bristly, unfinished appearance to the structures. Each nest was in an exposed situation, although only one was conspicuous from the ground.

During the construction period the kingbirds did not range far. Both sexes indulged in considerable calling and wing fluttering whenever one returned with nest material or, later, when they exchanged positions on the nest. Both members of a pair frequently flew to the nest together. One presumed male approached so near his mate that he clumsily interfered with her placement of the nest material. Away from the immediate vicinity of their nest, mated birds usually perched within a few yards of one another. Although vociferous throughout the day, they were unusually noisy at dawn and in the evening.

The kingbirds attacked any wandering Mexican Jay *(Aphelocoma ultramarina)* that ventured near the nest tree. Sparrow Hawks *(Falco sparverius)* feeding young nearby were seemingly ignored, but hunting Cooper's Hawks *(Accipiter cooperii)* were pursued with considerable vigor whenever they appeared. Such chases invariably involved both Thick-billed and Cassin's kingbirds *(T. vociferans)* and sometimes a Western Kingbird *(T. verticalis)* as well. Cassin's Kingbirds nested near each of the Thick-bill's nests, and in one case active nests of the two species were less than 75 feet apart, in adjacent trees.

Behavior of the adult Thick-billed Kingbirds at one nest (New Mexico) on 4 and 5 July indicated that they were feeding small young. At the other New Mexican nest the female, which had not acquired a new mate in the week following collection of the male, was evidently incubating or brooding small young.

At least five pairs of Thick-billed Kingbirds inhabited the United States portion

of Guadalupe Cañon in 1959, whereas Levy (verbal information) found but one pair in the Arizona portion, and none in New Mexico, in 1958. Oliver Milton made a general collection of birds in this cañon in 1957, but did not obtain this species. Other ornithologists had visited the area in previous years, apparently without encountering these conspicuous birds. Additional observations are needed to show whether they are merely irregular summer residents or a newly established, permanent addition to the avifauna of New Mexico and Arizona.

I wish to thank S. D. Ripley and P. S. Humphrey, of the Peabody Museum, Yale University, for furnishing me with information on the Milton Collection which is under their care.—DALE A. ZIMMERMAN, *Department of Biology, New Mexico Western College, Silver City, New Mexico.*

The Migratory Status of Some Western Desert Birds.—In a recent paper, MacArthur (Auk, 76: 320), speaking of the correlation of migration with a striking seasonal change in vegetation, stated that the proportion of Neotropical migrants breeding in western American desert habitats is "virtually none." He cites the uncertain nature of the "desert bloom" and the lack of seasonal contrast in food conditions as discouraging the establishment of breeding populations of such migrants.

A recent list of birds occurring on southern Nevada's warm deserts (Gullion, *et al.*, Condor, 61: 278–297, 1959) includes 10 species which are winter visitors to the Neotropical Region, or 22 per cent of the 46 species of native birds breeding in this area. In addition, a review of Linsdale's list of Nevada birds (Condor, 53: 228–249, 1951), and my unpublished field notes, shows that at least 16 (17 per cent) of about 96 native birds breeding in the cold desert region of central and northern Nevada are migrants to the Neotropical Region. Thus, a total of 23 species (19 per cent) among about 120 native birds breeding in Nevada's desert regions spend their winters in the Central American tropics, or farther south.

Although I must disagree with MacArthur concerning the absence of migrants from the Neotropics as breeding birds in western desert regions, there is no disagreement with his thesis that these migrants breed primarily in areas where striking seasonal changes in vegetation occur. More detailed examination of Nevada's desert areas reveals a wide diversity of vegetation types, with at least nine major types being apparent on the warm desert alone. An analysis of the warm desert habitats, and their avian occupants, shows that only two *(Myiarchus cinerascens* and *Icterus parisorum)* of the 10 Neotropical migrant species breeding on southern Nevada's Mohave Desert spend their summers in vegetation types which show little or no seasonal change. The other eight species are summer inhabitants of deciduous woodland areas, either mesquite bosques (*Prosopis* sp.) or riparian situations along stream courses and around springs and waterholes. Similarly, the cold desert areas farther north also provide a wide diversity of habitat conditions. If the cold desert is considered in the strictest sense, including only the seasonally unchanging shadscale *(Atriplex confertifolia)* and sagebrush (*Artemisia* sp.) covered flats and valleys, there are no birds breeding in this situation which are migrants to and from the Neotropical Region. But, if the mountain ranges rising above the desert terrain are included as part of the cold desert, with their deciduous riparian associations and extensive patches of aspen *(Populus tremuloides)*, chokecherry *(Prunus virginiana)* and other deciduous trees and shrubs, no fewer than 16 Neotropical migrants can be included in the breeding avifauna of the cold deserts of Nevada.

The species nesting in the deciduous woodlands of Nevada's warm desert spend their summers in situations which can be classified as desert in so far as climate is concerned (less than five inches of mean annual precipitation, a rate of evaporation which may exceed precipitation by a ratio of 22:1, and a July mean maximum temperature above 100°F). However, these are still deciduous woodlands, and the presence of a significant proportion of Neotropical migrants among the breeding avifauna agrees with MacArthur's main thesis. The cold desert environments occupied by the Neotropical migrants for breeding purposes are truly temperate, deciduous woodland areas, not unlike some parts of the deciduous forests of the western Great Lakes area. Again, the high incidence (both in species and individuals) of these migrants in the breeding avifauna of these areas agrees with MacArthur's conclusions.

Although some 23 species of Neotropical migrant birds breed in the desert regions of Nevada, only two of these species breed in truly desert situations, where little seasonal change in the vegetation aspect occurs. All but two (one predator, *Buteo swainsoni*, and one granivore, *Guiraca caerulea*) of these migrants are predominately insectivorous in habit, and 19 of these species seek their food among the foliage of deciduous trees and shrubs.

It should be pointed out that by far the majority of the breeding terrestrial birds on the Nevada deserts are predominantly insectivorous in habit. Of the 46 species breeding on the warm desert, 31 (67 per cent) are primarily insectivores, and seven (15 per cent) are primarily granivorous in habit. Farther north, on the cold deserts, at least 64 (67 per cent) of the 96 native breeding species are insectivorous, and about 11 (11 per cent)are largely dependent upon the seed or fruit production of plants for their livelihood.

The uncertainty of the desert bloom has not only discouraged colonization of western American desert areas by granivorous Neotropical migrants, but by resident and Nearctic migrant granivorous birds as well. Only seven of about 120 common breeding species on Nevada's deserts are closely dependent upon the seeds and fruits of plants for their survival. Two of these seven *(Gymnorhinus cyanocephala* and *Carpodacus mexicanus)* are gregarious, highly mobile species, capable of moving considerable distances from one food supply to another. Three more *(Zenaidura macroura, Pheucticus melanocephalus,* and *Guiraca caerulea)* are migrant species, adapted to seasonal scarcity of food (see also, Gullion, Proceed. Ann. Conf. West. Assn. State Game and Fish Comm., 38: 211, 1958). Of all the native species occurring on Nevada's deserts, two birds, *Pipilo aberti* and *Lophortyx gambelii*, must survive throughout the year upon the seeds produced in a narrowly circumscribed area on the warm desert. The former species' range is limited to the mesquite bosques, irrigated by underground water courses, where the annual seed production is relatively stable. Only *Lophortyx gambelii* lives on the upland desert areas where the seed production is entirely dependent upon local precipitation. This species, accordingly, is subject to severe fluctuations in the size of populations, depending upon the vagaries of the local climate (the well-established exotic, *Alectoris graeca*, lives under the same limitations on the cold desert farther north). Rodents, not resident birds, apparently utilize the bulk of any surplus seeds produced as the result of a desert bloom in Nevada.—Gordon W. Gullion, *Forest Research Center, University of Minnesota, Cloquet, Minnesota.*

REVIEWS

Fundamentals of Ornithology.—Josselyn Van Tyne and Andrew J. Berger. 1959. John Wiley and Sons, Inc. New York 16, N. Y. ix + 624 pp., 168 figs. $11.75.—On his death early in 1957, Van Tyne left an unfinished book designed as background for his graduate course in ornithology and as a general reference. He had completed what he regarded as the major contribution of the work, a summary of the main characters of each of the avian families of the world. He had plotted out the chapters to be included and had finished those on plumage and molt, migration, distribution, ornithological sources, and part of the glossary of ornithological terms. Berger, complying with a promise to Van Tyne, and in part on the basis of the latter's notes and card files, completed, or wrote entirely, chapters on paleontology, anatomy, senses and behavior, voice and sound production, flight, food and feeding habits, breeding behavior, social relations, taxonomy and nomenclature. The book contains a vast amount of well-organized information not elsewhere available under one cover. The chapters completed by Van Tyne were apparently left essentially as he wrote them, for reference lists following the chapters on distribution and migration include nothing published after 1954 and 1955 respectively.

The major chapter on bird families (amounting to about a third of the book) is a notably convenient and succinct compendium. Van Tyne recognized 168 families, deprecating the "unfortunate tendency" to reduce families to sub-families. His families are essentially those of Wetmore, whose order he follows. The major differences from the A. O. U. Check-list (1957) are that *Chamaea* is included in Timaliidae, the Coerebidae are dismembered (following Beecher) and the Carduelinae are transferred from the Fringillidae to the Ploceidae (following Tordoff). Each family is treated on a separate page, headed by an indication of the number of species in the family and an attractive drawing by G. M. Sutton of an included species. Summaries of family characters are given under such captions as: physical characteristics, range, habits (including voice), food, breeding. Selected references are provided for life-histories, technical diagnosis, and classification. The allocation of a single page to each family seems rather arbitrary, for some families include only one little known species (*e.g.*, Oxyruncidae, Zeledoniidae, Catamblyrhynchidae), while others are heterogeneous aggregations of hundreds of species having very different habits and appearance (*e.g.*, Accipitridae, 205; Tyrannidae, 365; Timaliidae, 282; Sylviidae, 398; Muscicapidae, 328; Thraupidae, 222; Ploceidae, 313; Fringillidae, 375). In dealing with these and other complex—and possibly polyphyletic—assemblages, it would have been more helpful to indicate important divergences of major, well-defined infra-family groups (particularly some of those recognized as families by others), rather than merely to list a series of characters (sometimes almost contradictory) found in the family, without designating to which subdivision they applied. Nevertheless, the summaries are useful, and informative, reflecting Van Tyne's broad knowledge and careful study.

Because written some years ago, the chapter on migration fails to mention the promising use of radar by Sutter and others, the studies of stellar orientation by Sauer, or the excellent reviews of various aspects of migration contained in "Recent Studies in Avian Biology" (1955). The statement (p. 206) that "no South American species is known to migrate into North or even Central America" does not represent present knowledge, even as applied to land birds.

As Berger is an anatomist, the anatomical sections are authoritative, and—better still—clearly written. Included is a helpful section, with many good drawings, describing the principal anatomical characters used in taxonomy. The discussion of behavior emphasizes that the way birds act depends on what they have to act with—their physical and physiological structure. In the treatment of plumage and molt, the generalization that "molt periods are very closely synchronized with the reproductive cycle and with seasons of the year", though usually true in higher latitudes, does not apply to all tropical birds.

The chapter on taxonomy and nomenclature, while basically sound, seems oversimplified for a graduate reference work. Reliance is mainly on Mayr's views. In discussing speciation no mention is made of Dobzhansky's theory—elaborated as to birds by Sibley—that *after* a secondary contact between previously isolated populations, reproductive isolating mechanisms may evolve to prevent the "wastage" resulting from unfavorable hybridization. In the section on polymorphism, one misses reference to the theory that balanced polymorphism may be maintained because the same gene that alters external appearance may also have a physiological effect, significantly advantageous in the heterozygous rather than the homozygous condition. Huxley's useful review, *Morphism in Birds* (1955), is not listed. Incidentally, the illustration of the drongo, *Dicrurus hottentotus*, under the heading "Individual Variation" with the statement that it is "one of the most variable of birds", seems a misinterpretation. That drongo shows extraordinary *geographic, not individual* variation. On the species-subspecies problem one unqualified quotation could mislead students as to current taxonomic practice, and, because earlier explanatory sentences are omitted, as to the quoted author's opinion: ". . . it is preferable for practical as well as scientific reasons to treat *all* doubtful allopatric populations as subspecies. The scientific reason is that the mere fact that a population was unable to overlap the range of its nearest relatives implies that it has been unable so far to develop isolating mechanisms that would permit coexistence" (italics ours). As the taxonomic status of all closely allied but geographically separated bird populations is "doubtful", in the sense that one cannot prove or disprove the existence of reproductive isolating mechanisms, to follow the practice suggested would result in making conspecific numerous forms that everyone has always treated as species. Nor would it be "scientific". If it is true that speciation occurs chiefly through the development of reproductive isolating mechanisms during geographic isolation, then some allied allopatric populations now existing are certain to have attained species rank. Failure to overlap does not imply lack of reproductive isolation when there are geographical barriers; and even when no such barriers exist, competition, rather than lack of isolating mechanisms, may keep adjacent populations from overlapping. Some will say that it is unimportant whether a population of uncertain status is called a species or a subspecies. But most men (even ornithologists) think, or at least react, in terms of names. Naming the beasts and birds was Adam's first reported act (Genesis, ii, 20)! Today a strong, and sometimes justifiable, tendency exists to disdain subspecies. Students are likely, therefore, to overlook possibly important differences in behavior and other characters, once a form has been reduced to subspecific status. There is thus a practical disadvantage in prematurely relegating to the ornithological limbo of subspecies those strikingly distinct, non-intergrading, populations that by long isolation may also have developed mutually inharmonious genetic constitutions and —for all we know—reproductive isolation.

The probability that this exceptionally well-prepared and useful book will be

cited as authority made it seem desirable to call attention to some omissions and questionable generalizations. Ornithology has reached a stage of such specialization, with an overwhelming proliferation of publications, that it is impossible for a student to keep current in all fields. One wonders also whether it is now feasible in a single volume to do full justice even to the fundamentals of ornithology. Within its scope the present book is the best available in English.—EUGENE EISENMANN.

Comparative Biosystematics and Life History of the Nuthatches *Sitta pygmaea* and *Sitta pusilla*.—Robert A. Norris. 1958. Univ. Calif. Publ. Zool. 56, no. 2: 119–300, 13 text figs. $3.50. The Brown-headed Nuthatch *(Sitta pusilla)* is a resident of the southern United States, eastward from Texas and Oklahoma. The closely allied Pygmy Nuthatch *(Sitta pygmea)* ranges through the mountains and humid coastal regions of the western states, from British Columbia southward through the Mexican highlands. Norris made intensive field studies of a color-banded population of nominate *pusilla* in southern Georgia and of nominate *pygmaea* in Marin County, California. In addition, a systematic study involving over 2,000 specimens was undertaken.

Obviously similar in many ways, these forms have been considered by some workers to be well-marked geographic races of the same species. Norris' findings —morphologic, ecologic, and ethologic—are copious and meticulously analyzed and presented in full detail. Morphologically, there is no overlap in qualitative differences in head coloration, tail pattern, and skull characteristics, and there are highly significant differences in skull measurements. Considerable importance is attached to differences in the pitch of their voices, the height of their nests, breeding chronology, territory size, roosting behavior, attentiveness and other aspects of their breeding biology. The author considers these differences, viewed collectively, to be significant at the species level and that potential reproductive isolation and full specific status have been attained.

Practical and theoretical difficulties plague the study of closely allied populations of birds that are allopatric in their distribution. Without recourse to a criterion involving degree of interbreeding, the student must base his opinion as to their systematic status on an evaluation of differences and similarities in other aspects of their biology. Norris has done this in a most scholarly manner, with useful comparative tables. The reality of differences in behavior, as interpreted by Norris in his two banded populations, may subsequently be challenged by workers more familiar with these nuthatches in other parts of their respective ranges. Such behavioral phenomena as territory size, materials used in nidification, productivity, boldness at the nest, attentiveness at the nest, and others considered by Norris are well known to vary both temporally and spatially in other species, depending upon the environmental situation in all its complexity. However, there can be no argument as to the objective reality of the morphological differentiation attained by these allopatric populations. Perhaps this alone substantiates the ultimate conclusion of species rank for each.—W. E. LANYON.

A Field Guide to Bird Songs of Eastern and Central North America.—Arranged to accompany, page by page, Roger Tory Peterson's A Field Guide to the Birds. Recorded under the direction of Peter Paul Kellogg and Arthur A. Allen, in collaboration with Roger Tory Peterson. 1959. Houghton Mifflin Co., Boston. Two 33⅓ RPM recordings (four sides). $10.00.—These discs reproduce voices of over 300 species, from recordings in the Cornell University Laboratory

of Ornithology, which has pioneered in a field that will increasingly throw light on many aspects of ornithology. Its library of bird song tapes, doubtless the largest in the United States, has been freely open to the students. The present issue makes available to the public the most comprehensive series of North American bird sounds yet recorded under one title. The samples for each species are brief, and the jacket wisely warns that local "song dialects" may exist, indicating in what state or province each recording was made. Helpful, too, is the characterization of a vocalization as a song or as a call, occasionally with brief mention of the activity it accompanied.

Many of the songs (*e.g.*, Bachman's Warbler) here included have not been previously available on a record. How much remains to be done is indicated by the fact that only about 70 per cent of the 440 species treated in the main text of Peterson's eastern guide are represented. Most of those omitted are nonpasserine species breeding in remote areas or birds merely casual in the eastern states. But some omissions are surprising, for they involve birds occurring regularly, or even nesting, in the East. As many rarer nonsongbirds are included, one must assume that the Cornell Laboratory lacked adequate recordings of these omitted species. In the hope of encouraging others to make such tapes available to the Laboratory —and thus to students generally—some of the more vocal of such birds are here mentioned. Among the missing nonpasserines are: Horned Grebe, Mottled Duck, Green-winged Teal, Golden Eagle, Short-tailed Hawk, Peregrine Falcon, Spruce Grouse, Black Rail, American Oystercatcher, Snowy and Wilson's Plovers, Ruddy Turnstone, most of the sandpipers (Solitary, Purple, Pectoral, Baird's, White-rumped, Western, Sanderling, and Knot), Long-billed Dowitcher, many of the terns (Forster's, Roseate, Sooty, Royal, Sandwich, and Noddy), White-crowned Pigeon, Mangrove Cuckoo, Saw-whet Owl, Red-cockaded and Northern Three-toed Woodpeckers. Though most of these shorebirds breed in the far north, their diagnostic calls are frequently heard on migration in areas frequented by bird watchers. Almost all the native passerines nesting in the East are accounted for, but among the missing are such familiar birds as Gray Kingbird, Gray and Scrub Jays, Brown-headed Nuthatch, Golden-crowned Kinglet, Northern Shrike, Water Pipit, Red Crossbill, Painted and Snow Buntings. Florida workers should be able to get recordings of many of the foregoing, as well as of the endemic Cape Sable and Dusky Seaside Sparrows. Though calls, as well as songs, of many species are given, there are some regrettable omissions, notably the diagnostic calls of the Downy Woodpecker and certain thrushes.

In a publication of this kind, there is always a difficult problem of selection. But to achieve the completeness which is a major feature of the Peterson bird guides, there will have to be a sample of the basic song patterns and major calls of each species in the area. This would surely require three discs, and presumably a higher price. Nevertheless, the public that avidly buys the field guides would pay the price of a song guide of equal ingenuity and thoroughness. While not attaining this level, the present record is very welcome and well worth the price. —E. Eisenmann.

Instructions to Young Ornithologists. Bird Biology.—J. D. Macdonald. 1959. Museum Press Ltd., 26 Brompton Road, London, S.W. 7, England. 128 pp., 16 photos., 20 text figs. 12s. 6d.—Contrary to what one might expect from the title, this book does not deal with methods of bird collecting or even of recording observations. It is an introduction to avian biology by the keeper of

the great bird collection in the British Museum (Natural History). While written generally in a colloquial style, presumably because part of a series designed for young people, this work is no juvenile; nor is it light reading. Almost half the text is devoted to a survey of bird anatomy and morphology. Many professional ornithologists and experienced bird watchers would find instruction in this little work. The reviewer did.—E. EISENMANN.

La Quaglia. Vita—Caccia—Allevamento.—Augusto Toschi. 1959. Laboratorio di Zoologia Applicata alla Caccia, Univ. Bologna, Italy. Suppl. Ricerche Zool. Appl. Caccia, 3 no. 1. 267 pp., 55 figs. (many in col.). Lire 2800.—This is a survey of the quail genus *Coturnix*, with particular reference to the life history, rearing in captivity, and methods of hunting and trapping the European and Japanese forms, *C. coturnix coturnix* and *C. c. japonica*. As in the United States, considerable experimentation is being done in Italy with a view to the introduction of the Japanese race, which is less migratory than the native subspecies. In captivity the semidomesticated Japanese females have been reported to lay at the early age of 35 days, but the author says the young are weak unless the parents are at least 50 days old. In Japan some females are said to lay 30 eggs a month and 365 a year, with high productivity lasting a year or a year and a half. A good bibliography on the genus *Coturnix* is included.—E. EISENMANN.

Raubvögel und Eulen der Heimat.—Otto Kleinschmidt. 1958. Third ed. A. Ziemsen Verlag, Wittenberg-Lutherstadt, Germany. xx + 94 pp., 61 col. pls., and 17 photos or drawings.—This posthumous revision of a popular work on the hawks and owls of Germany has more than local interest. It provides a color plate with a well-organized, succinct, one-page summary of the major life-history facts of 46 species (many of them Holarctic). Half the book is devoted to miscellaneous (and illustrated) aspects of hawk and owl biology, including double-down development, individual variation, differences in feather markings of adult and immatures, and the geographic forms (on the "Formenkreis" theory) of Peregrine Falcon, Gyrfalcon, and Goshawk. Those interested in field marks will find useful the photographs of flight patterns, showing how a *soaring* Goshawk (unlike the smaller *Accipiter nisus*) fans out its tail broadly, so that, with its heavy body and widely spread wings, it looks much like a *Buteo*. The bibliography at the end is conveniently arranged by species, supplying references to two or more recent articles for almost every species. The technical nomenclature, following the author's well-known views, deviates in some instances from that customary, but no difficulty will be encountered in recognizing the bird intended. —E. EISENMANN.

A Bibliography of Birds. With Special Reference to Anatomy, Behavior, Biochemistry, Embryology, Pathology, Physiology, Genetics, Ecology, Aviculture, Economic Ornithology, Poultry Culture, Evolution and Related Subjects.—Reuben Myron Strong. 1959. Pt. 4. Finding Index. Field Mus. Nat. Hist., Zool. Ser., 25, pt. 4: 1–186. $2.75.—This is the concluding volume of a monumental bibliography; the earlier parts, Author Catalogue and Subject Index, appeared in 1939 and 1946 (see reviews Auk, 57: 264–265, 1940; 64: 478, 1947). Expressly omitting the fields of taxonomy and distribution (although many of the major faunal books and papers to 1938 are listed), this bibliography attempts to cover all significant papers in its field through 1926, and includes many published through 1938. The present Finding Index facilitates the use of the treasury

of information contained in the preceding volumes. It is a simple alphabetical index referring to the various pages of the complex Subject Index, where subjects are more elaborately treated (with author and date given). A Corrigenda to the preceding parts is included. With the constantly increasing flood of ornithological literature, a good bibliography, such as this, is essential.—E. EISENMANN.

RECENT LITERATURE

EDITED BY FRANK McKINNEY

ANATOMY AND EMBRYOLOGY

DUIJM, M. 1959. On the position of a ribbon-like central area in the eyes of some birds. Arch. Néerlandaises Zool., **13**, Suppl. 1: 128–145.—Review of the known occurrence of a ribbon-like ridge visible on macroscope examination of the retina in some birds. Although presence or absence seems to run in families, some genera of the same family and even some species in the same genus may lack it while others show the ribbon-like area; *e.g., Corvus brachyrhynchos* is reported to have it and *Corvus corone cornix* to lack it. The author believes that the head of a bird is held in a way that tends to place the ribbon-like area in horizontal position and that this may serve in spatial orientation. (In English.) —E. E.

KAMAR, G. A. R. 1959. Developmental changes in the reproductive organs of the male Fayomi fowl. Poultry Sci., **38**: 775–781.

LINDENMAIER, P. and M. R. KARE. 1959. The taste end-organs of the chicken. Poultry Sci., **38**: 545–550.

MEUNIER, K. 1959. Die Allometrie des Vogelflügels. Zeitsch. wissensch. Zool., **161**: 444–482.—The relations of bird wing dimensions to body weight, size, type of flight, treated mathematically from an aerodynamic viewpoint.—E. E.

RIGDON, R. H. 1959. The respiratory system in the normal white pekin duck. Poultry Sci., **38**: 196–210.—Gross and fine anatomy of the respiratory tract are studied by injection of latex and of ink as well as by histological methods. Number of connections of the nine air sacs, extent of pneumaticity of bones, and a peculiar feature of the parabronchi in that groups of them terminate as large air spaces at the surface of the lungs are described.—P. H. B.

BEHAVIOR

ALDER, J. 1957. The Dipper's winking. Brit. Birds, **50**: 267–269.

BARBER, D. R. 1959. Singing pattern of the common chaffinch, *Fringilla coelebs* Linn. Nature, **183**: 129.—Differences in breeding song activity exist between bird populations in different parts of the country.—H. C. S.

BLUME, D. and G. JUNGE. 1959. Beobachtungen an Grauspechten *(Picus canus)* im Hessischen Hinterland. Vogelwelt, **80**: 65–74.—Behavior notes on the Grey-headed Woodpecker in Germany. Drawings showing comparative peering postures of four European woodpeckers when disturbed from their holes, and tables comparing the behavior of *P. canus* with the allied Green Woodpecker *(P. viridis)* are interesting.—E. E.

BOSIGER, E. and J. LECOMTE. 1959. Sur les réactions des mésanges a des modifications apportées a leur nid. Alauda, **27**: 16–21.—Reactions of the Blue and Great Tits *(Parus caeruleus* and *P. major)* to modifications of their nest. Though tits nest in dark holes, when wooden bird boxes in which they were incubating had one side replaced by a pane of glass they rarely abandoned them. —E. E.

CHISHOLM, A. H. 1959. The history of anting. Emu, **59**: 101–130.—A useful review of the major literature and theories of "anting," adding many Australian records not included in recent papers. The view is advanced "the general purpose of anting, in its various phases, is the stimulating and soothing of the body" and "has affinity with the impulse of birds to submit themselves to the influences of dust, water, sun, smoke, steam and air."—E. E.

CONWAY, W. G. 1959. The behavior of two captive ostriches at a burning leaf pile. Wilson Bull., **71**: 188–189.—Two *Struthio camelus* repeatedly "bathed" in the smoke of burning leaves. The possible relation of this behavior with anting, dusting, etc. is discussed.—J. T. T.

DORST, J. 1959. Impressions ornithologiques aux îles Galapagos. L'Oiseau, **29**: 77–87.—Most birds are remarkably fearless in the Galapagos. *Dendroica petechia* enters houses to pick insects off window screens; it is most frequently seen on the ground or on the rocks of the sea shore.—E. E.

FUSHIWARA, H. 1959. Anting by the Japanese Grey Thrush, *Turdus cardis cardis* Temminck. Tori, **15**: 61–70.—A captive bird in an excited state as a result of injection of pituitary body hormone and testicle hormone anted with ants, but did not eat them. The writer suggests that the formic acid "acts as protoplasma poison and consequently histamine is produced in the bird's body" which "excites parasympathetic nervous system and . . . represses antagonistically exciting sympathetic nervous system," thus eliminating stress. (In Japanese; English summary.)—E. E.

GILLIARD, E. T. 1959. Notes on the courtship behavior of the Blue-backed Manakin *(Chiroxiphia pareola)*. Amer. Mus. Novitates, 1942: 19 pp.—Observations made on Tobago Island, March 16–19, 1958. Half of the paper consists of detailed excerpts from field ledger, illustrated by sketches of complex dances of this species. Two forms of dance noted: a vertical "cartwheel" involving two males, and a "bouncing" dance of one to four males. Four "bowers" were used interchangeably by the group of males studied. Gilliard's observations differ in several respects from those of Snow on the same species in the same general area, particularly in that Gilliard never saw a female enter the display area. It is postulated that the clearing of leaves and other objects from display areas by manakins, birds of paradise, and bowerbirds is a defensive mechanism to deprive predators, attracted to the area by the displaying birds, of cover. —K. C. P.

LEHTONEN, L. 1959. [On the effect of the eclipse of the sun on the daily rhythm and behavior of birds.] Ornis Fennica, **36**: 41–42.—The behavior of various birds in Finland during an 89 per cent eclipse on June 30, 1954. (In Finnish; German summary and table legends.)—E. E.

MEYERRIECKS, A. J. 1959. Foot-stirring feeding behavior in herons. Wilson Bull., **71**: 153–158.—Three species of herons of southern Florida used their feet in different ways to disturb fish for easier catching by the herons. The methods are described and compared with published descriptions of those of other species. —J. T. T.

MITCHELL, K. D. G. 1957. Further aircraft observations of birds in flight. Brit. Birds, **50**: 291–302.

MOUNTFORT, G. 1957. Nest-hole excavation by the Bee-eater [*Merops apiaster*]. Brit. Birds, **50**: 263–267.

MYRES, M. T. 1959. Display behavior of Bufflehead, Scoters, and Golden-eyes at copulation. Wilson Bull., **71**: 159–168.—The movements associated with copulation in five species of ducks *(Bucephala albeola, B. islandica, B. clangula, Melanitta deglandi, M. perspicillata)* are described and compared. These displays are more conservative, in an evolutionary sense, than are courtship displays.—J. T. T.

O'DONALD, P. 1959. Possibility of assortive mating in the Arctic skua. Nature, **183**: 1210–1211.—Departure from random mating among color phases of Arctic skua is indicated.—H. C. S.

PAULIAN, P. 1959. Observations sur l'aptitude à la plongée chez les Procellariiformes. L'Oiseau, **29**: 128–130.—Comments on the diving ability of various petrels and albatrosses.—E. E.

RIPLEY, S. D. 1959. Competition between sunbird and honeyeater species in the Moluccan Islands. Amer. Nat., **93**: 127–132.—Two pairs of sunbirds *Nectarinia sericea* had their territories within the much larger territory of a honeyeater *Myzomela obscura*. The two species are of similar size and feed on the same flowers. The honeyeater was highly aggressive, and when attacked the sunbird meekly left the food tree to await the honeyeater's departure to another part of its extensive foraging area. Despite submissiveness the sunbird is much commoner than the honeyeater. It is suggested that the latter's aggressiveness tends to limit successful reproduction, resulting in a smaller population.—E. E.

SCHWAB, R. G. and J. B. MONNIE. 1959. Strife over a nesting site between Downy [*Dendrocopos pubescens*] and Red-headed [*Melanerpes erythrocephalus*] Woodpeckers. Wilson Bull., **71**: 190–191.—The Redheads won.—J. T. T.

SELANDER, R. K. and D. R. GILLER. 1959. Interspecific relations of woodpeckers in Texas. Wilson Bull., **71**: 107–124.—The very similar *Centurus carolinus* and *C. aurifrons* are sympatric in a narrow zone near Austin, Texas, where they usually inhabit different habitats. Both species occur in the city of Austin, defending mutually exclusive territories. Interspecific antagonism did not occur between a pair of *C. carolinus* and one of *Melanerpes erythrocephalus*.—J. T. T.

SIMMONS, K. E. L. 1956. Feather-eating and pellet-formation in the Great Crested Grebe. Brit. Birds, **49**: 432–435.

SKEAD, C. J. 1959. A study of the Redshouldered Widowbird *Coliuspasser axillaris axillaris* (Smith). Ostrich, **30**: 13–21.—This African Ploceid is remarkable for its similarity in both male and female plumages to an American Icterid, of like habitat, the Red-winged Blackbird *(Agelaius phoeniceus)*. *C. axillaris* males are territorial and generally polygamous (though some males succeed in attracting only one nesting female). The male builds one or more loose network nests, and within this framework a female builds a compact nest chamber.—E. E.

SMITH, R. L. 1959. The songs of the Grasshopper Sparrow. Wilson Bull., **71**: 141–152.—Four songs of *Ammodramus savannarum* are described, as are their functions: proclaiming territory, attracting a female, etc.—J. T. T.

STENGER, J. and J. B. FALLS. 1959. The utilized territory of the Ovenbird. Wilson Bull., **71**: 125–140.—The utilized territories of male *Seiurus aurocapillus* were smallest in dense aspen, largest in open mixed stands. The changes in utilized territory with changing breeding activities are described.—J. T. T.

THORPE, W. H. 1956. Records of the development of original and unusual feeding methods by wild passerine birds. Brit. Birds, **49**: 389–395.

THORPE, W. H. 1959. Talking birds and the mode of action of the vocal apparatus of birds. Proc. Zool. Soc. Lond., **132**: 441–455.—The vocal apparatus of the more primitive birds is believed to act like a wind instrument. The syrinx in many song birds can be compared to the human vocal apparatus; sound spectrographs indicate that some species must have two or more separately modifiable resonant chambers, though anatomical studies are insufficient to enable more than a guess to be made as to their location.—E. E.

VALVERDE, J. A. 1959. Moyens d'expression et hiérarchie sociale chez le Vautour fauve (*Gyps fulvus* (Hablilz)). Alauda, **27**: 1–15.—Behavioral means by which the temporary feeding hierarchy in the Griffon Vulture is maintained. The author believes dominance is mainly determined by hunger.—E. E.

DISEASES AND PARASITES

BELLROSE, F. C. 1959. Lead poisoning as a mortality factor in waterfowl populations. Ill. Nat. Hist. Surv. Bull., **27**, art. 3: 235–288.—Annual loss of North American waterfowl due to lead poisoning estimated 2–3 per cent.—E. E.

OWEN, D. F. 1957. Neottiophilum praeustum in birds' nests. Brit. Birds, **50**: 160–164.

SALES, V. A. D. 1957. D.D.T. poisoning of birds. Brit. Birds, **50**: 20–22.

DISTRIBUTION

ANDERSON, N. L. 1959. The incidence of ducks and geese in the Asheville, North Carolina, area during fall, winter, and spring migration. Chat, **23**: 25–27.—Water impoundments have attracted formerly unusual species.—E. E.

BOND, J. 1959. Fourth supplement to the Check-list of Birds of the West Indies (1956): 1–12. Acad. Nat. Sci. Phila.—Additional records, including corrections, taxonomic notes, and migration data. Gives dates when Cattle Egret was first reported from the various islands. Among most interesting are specimens from Barbados of *Haematopus ostralegus prattii, Charadrius melodus, Tringa glareola, Philomachus pugnax* (many), *Larus delawarensis, Cuculus canorus, Apus melba* (the last two first records for the Western Hemisphere); and from Martinique of *Diomedea melanophrys*.—E. E.

BROSSET, A. 1959. Les oiseaux de la Moulaya (Maroc Oriental). Les migrateurs. Alauda, **27**: 36–65.—Migrants in eastern Morocco.

BULL, P. C. 1959. Birds of the Hutt Valley [New Zealand]. Proc. N.Z. Ecol. Soc., no. **6**: 52–58.—Local movements of various species described, particularly dispersal pattern of the introduced Blackbird *(Turdus merula)* and Song Thrush *(Turdus ericetorum)*. An annotated list of the birds of the area is included.—E. E.

CATUNEANU, I. I. 1958. [The nesting colonies of the Danube delta and the need for creating an ornithological reserve.] Ocrotierea Naturii, **3**: 79–115. Acad. Romanian People's Rep.—The location of nesting colonies and migration routes in the Danube delta, with many maps. (In Romanian; French and Russian summaries.)—E. E.

DELEUIL, R. 1959. Sur quelques oiseaux observés dans les Alpes entre 1,600 et 2,400 mètres (Région du Lauzet-Lauteret). L'Oiseau, **29**: 131–141.—Notes on birds in the French Alps.—E. E.

EATON, S. W. 1959. The Tufted Titmouse invades New York. Kingbird, **9**: 59–62.

FUNDERBURG, J. B., JR. and T. L. QUAY. 1959. Summer maritime birds of southeastern North Carolina. Jour. Elisha Mitchell Sci. Soc., **75**, no. 1: 13–18.

HALL, C. F., J. E. HILDEBRAND, R. T. BINHAUMER, and O. T. HALL. 1959. The birds of Galveston Island. Texas Jour. Sci., **11**: 93–109.—A species list.

HAWAII AUDUBON SOCIETY. 1959. Hawaiian Birds. Honolulu, Fisher. Pp. i-iv, 1–60.

HOUSTON, G. S. and M. G. STREET. 1959. The birds of the Saskatchewan River. Carlton to Cumberland. Saskatchewan Nat. Hist. Soc., Spec. Publ., no. **2**: 1–205. Price, $1.50.—An annotated list of the birds of an area in central Saskatchewan, with bibliography, and historical and biographical notes. Those regarding the Franklin expeditions have importance in systematics.—E. E.

JONES, S. B. and P. E. H. JONES. 1959. Crowned cranes in Cambridgeshire. Nature, **183**: 560.—Two adult and two immature *Balearica pavonica*.

KOLSCH, E. 1959. Verbreitung und Oekologie des Ortolans *(Emberiza hortulana)* in der Vorderpfalz. Vogelwelt, **80**: 74–83.—Documents the recent spread of the Ortolan into the Palatinate, Germany, and its ecology.—E. E.

LABITTE, A. and A. LANGUETIF. 1959. Notes sur les oiseaux nicheurs de l'Ile Dumet en 1958. L'Oiseau, **29**: 142–156.—Nesting birds (chiefly sea birds) on an islet off the French Atlantic coast.—E. E.

MOORE, N. W. 1957. The past and present status of the Buzzard [*Buteo buteo*] in the British Isles. Brit. Birds, **50**: 173–197.

PHILLIPS, W. W. A. 1958. 1956 Supplement to the (1952) revised check-list of the birds of Ceylon. Spolia Zeylanica, **28**: 183–192. Natl. Mus. Ceylon.

PHILLIPS, W. W. A. and R. W. SIMS. 1958. Some observations on the fauna of the Maldive Islands: Part III—Birds. Jour. Bombay Nat. Hist. Soc., **55**: 195–217.—Annotated list of all species. The small breeding shearwater is not *persicus*, but *Procellaria (Puffinus) lherminieri bailloni*. Suggests that *persicus* be considered a race of *P. lherminieri*.—E. E.

PIECHOCKI, R. 1958. Beiträge zur Avifauna Nord- und Nordost Chinas (Mandschurei). Abhandl. u. Ber. Staatl. Mus. Tierk. Dresden, **24**: 105–203.—Report on birds collected on the Chinese-German expedition to northern and northeastern China, May to September, 1956. 190 species are treated, with measurements, weights, and often data on molt, nesting, and behavior. The area covered extended from Shantung province north into Manchuria and Inner Mongolia. —E. E.

PINTO, ANTONIO A. DA ROSA. 1958. A contribution towards the study of the avifauna of the island of Inhaca. Bol. Soc. Estudos Moçambique, **27**, nr. 112, Sept.-Oct., 29–62.—Partial list, in a general symposium on the natural history of this island, located at the entrance of Lourenço Marques Bay, southern Mozambique.

RAYNOR, G. S. 1959. Recent range extension of the Veery on Long Island. Kingbird, **9**: 68–69.

RICHARDSON, R. A., M. J. SEAGO, and A. C. CHURCH. 1957. Collared Doves [*Streptopelia decaocto*] in Norfolk: a bird new to the British list. Brit. Birds, **50**: 239–246.

RINGLEBEN, H. 1959. Für Niedersachsen neue Brut- und Gastvögel. Bertr. Naturk. Niedersachsens, **12**: 4–36.—New records of breeding birds and accidentals from Lower Saxony, Germany. (In German.)—E. E.

RUSCHI, A. 1959. A Trochilifauna de Brasilia, com a descrição de um novo representante de *Amazilia* (Aves). E o primeiro provoamento com essas aves ai realizado. Bol. Mus. Biol. Prof. Mello-Leitão. Biologia, no. **22**: 1–16.—The hummingbirds of Brasilia, the new capital of Brazil. *Subsp. nov.: Amazilia versicolor kubtcheckei*.—E. E.

SAMS, J. R. and K. STOTT, JR. 1959. Birds of San Diego County, California: an annotated checklist. Occ. Pap. San Diego Soc. Nat. Hist., no. **10**: 1–49.

SICK, H. 1959. O redescobrimento no Brasil do bacurau Caprimulgus longirostris Bonaparte (Caprimulgidae, Aves). Bol. Museu Nacional n. s. Zool. no. **204**: 1–15, photo. Rio de Janero, Brazil.—Rediscovery of the nightjar *Captimulgus longirostris longirostris* Bonaparte in Brazil; taken at several highland localities in the states of Minas Gerais and Rio de Janero, and heard (and a tail feather found) within the Federal District at Rio. Distribution, habitat, behavior, and voice described (compared with that of *C. maculicaudus*). A letter in English from E. Mayr contains taxonomic notes on subspecies and descriptive data. (In Portuguese; summary in German.)—E. E.

VARIOUS AUTHORS. 1957. The rarer birds of prey. Their present status in the British Isles. Brit. Birds, **50**: 129–155.—Reviews the status of Golden Eagle, Goshawk, Kite, Honey Buzzard, Marsh Harrier, Hen Harrier, Montagu's Harrier, Osprey, Hobby, and Peregrine detailing many changes which have taken place in recent years.—F. M.

WETMORE, A. 1959. The birds of Isla Escudo de Veraguas, Panamá. Smith. Misc. Coll., **139**, no. 2: 1–27.—Birds seen or taken on March 1–2, 1958, on a small wooded island off the Caribbean coast of western Panama. New subsp. described: *Manacus vitellinus amitinus, Thryothorus nigricapillus odicus, Thraupis virens caesitia*. Differentiation from the forms of the nearby mainland is interesting, because this island must have been connected with the mainland during the glacial stages of the Pleistocene. *Progne subis* migrating northward along the coast Feb. 18–March 6.—E. E.

WILLIAMSON, K. 1957. A desert race of the Great Grey Shrike [*Lanius excubitor pallidirostris*] new to the British Isles. Brit. Birds, **50**: 246–249.

WILLING, R. L. 1958. Australian discoveries of Emperor penguin rookeries in Antarctica during 1954–57. Nature, **182**: 1393–1394.—Five additional rookeries discovered; a map shows their location.—H. C. S.

WILSON, J. E. 1959. The status of the Hungarian Partridge in New York. Kingbird, **9**: 54–57.

ZIMMERMAN, D. A. and J. VAN TYNE. 1959. A distributional check-list of the birds of Michigan. Occ. Pap. Mus. Zool. Univ. Mich., **608**: 1–63.—326 species (356 forms) of which 215 have bred. Accounts of distribution are based largely on collected specimens; localities and dates are given where 10 or fewer Michigan records exist or where most records are unpublished.—E. E.

ECOLOGY AND POPULATION

BOYD, A. W. 1957. Sewage-farms as bird-habitats. Brit. Birds, **50**: 253–263.

BRERETON, J. L. and C. SOURRY. 1959. Some observations on the distribution and abundance of closely-related parrots of the New England District of New South

Wales. Emu, **59**: 93–100.—Ecological comparison of three Australian parrots: *Platycercus elegans* and *eximius* and *Psephotus haematonotus*.—E. E.

DHARMAKUMARSINHJI, R. S. 1958. Ecological study of the Great Indian Bustard Ardeotis nigriceps (Vigors) [Aves:Otidae] in Kathiawar, Peninsula, Western India. Jour. Zool. Soc. India, **9**: 140–152.

MERCER, B. V. 1959. 'At sea' observations of pelagic birds and the assessment of population densities. Bird Notes, **28**: 418–425.—An ingenious method of estimating population densities from a moving ship.—E. E.

NOVAES, F. C. 1958. As aves e as comunidades bióticas no alto Rio Juruá, Território do Acre. Bol. Mus. Paraense Emilio Goeldi. n.s. Zool., no. **14**: 1–14.—Describes the distribution in different habitats and vertical stratification in a forest in Amazonian Brazil of various species and families.—E. E.

RATCLIFFE, F. N. 1958. Factors involved in the regulation of mammal and bird populations. Australian Jour. Sci., **21**: 79–87.

TUTMAN, I. 1959. [Ornithophaenological notes from Dubrovnik, Jugoslavia, and vicinity.] Larus, **11**: 75–103.—(In Jugoslav; German translation.)

Evolution and Genetics

JEROME, F. N. and C. M. HUNTSMAN. 1959. A gynandromorph which arose from a sex-linked cross. Poultry Sci., **38**: 727–731.—Produced by a cross of New Hampshire male by Barred Rock female.—P. H. B.

SIBLEY, C. G. and P. A. JOHNSGARD. 1959. An electrophoretic study of egg-white proteins in twenty-three breeds of Domestic Fowl. Amer. Nat., **93**: 107–116.—The variation in egg-white proteins of distinct breeds of *Gallus gallus* was no greater than expected as normal errors in the technique, thus indicating that such protein structures are phylogenetically conservative.—E. E.

UDAKAWA, T. 1956. Karyogram studies in birds VIII. The chromosomes of some species of Turdidae and Troglodytiidae (sic). Jap. Jour. Zool., **12**: 105–111.—Chromosomes of *Turdus cardis, Luscinia akahige* (two subspecies), *Troglodytes troglodytes fumigatus*, and *Cinclus pallasii hondoensis*. No visible chromosomal difference was detected between the *Turdus* and other Asiatic species of this genus previously studied. *Troglodytes* showed a closer similarity to the *Turdus* group than to *Cinclus; Troglodytes* has the same chromosome formula (with some differences in the macrochromosomes) as the Daurian Redstart *Phoenicurus a. aureus*. Of these species *Cinclus* was the most widely divergent.—E. E.

General Biology

ANDERSEN, F. S. 1959. Bills, eggs, and nests of captured Arctic Terns (*Sterna paradisaea* Pont.) and Common Terns (*Sterna hirundo* L.). Dansk Ornith. Foren. Tidssk., **53**: 84–102.—Birds banded and examined in a Danish breeding colony over an eight-year period. About a third of the Arctic Terns and all Common Terns had blackish bill tips; bills of the former averaged significantly smaller but there was a wide overlap. In 9 per cent of the Arctic Terns the clutch was three eggs (the usual clutch was two); but two 14-year-old birds and a 10-year-old laid only one egg. Clutches of Arctic Terns in Greenland average smaller. Data on egg sizes, return to nest sites, banding recoveries are given. (In English; Danish summary.)—E. E.

Boyd, H. 1957. Early sexual maturity of a female Mallard. Brit. Birds, **50**: 302–303.—A female Mallard, probably hatched after the beginning of May, was banded in September and retrapped with a brood on November 6.—F. M.

Carvalho, C. T. de. 1958. Notas ecológicas sobre *Coereba flaveola*. (Passere, Coerebidae). Bol. Mus. Paraense Emilio Goeldi. n.s. Zool., no. **10**: 1–10.—Notes on feeding, song, reproduction, development of nestlings, and other behavior of the Bananaquit in Brazil. (In Portuguese; English summary.)—E. E.

Davis, P. 1957. The breeding of the Storm Petrel. Brit. Birds, **50**: 85–101, 371–384.—A detailed study of *Hydrobates pelagicus* made at Skokholm, Pembrokeshire, deals with many aspects of breeding biology and behaviour from the pre-egg stage through the development of the chick.—F. M.

Davis, T. A. W. 1956. Gulls feeding on grain. Brit. Birds, **49**: 400–404.

Feindt, P. and K. Reblin. 1959. Die Brutbiologie des Mittelspechts *Dendrocopos medius medius* (L.). Beitr. Naturk. Niedersachsens, **12**: 36–48.—Breeding biology of the Middle Spotted Woodpecker.

Geiler, H. 1959. Geschlechterverhältnis, Korpergewicht und Flugellänge der Individuen einer mitteldeutschen Sperlingspopulation. Beitr. z. Vogelkunde, **6**: 359–366.—Sex ratio, body weight, and wing length in a German House Sparrow *(Passer domesticus)* population.—E. E.

Gibb, J. and P. H. T. Hartley. 1957. Bird foods and feeding-habits as subjects for amateur research. Brit. Birds, **50**: 278–291.

Gillham, E. H. 1957. Notes on Tufted Duck in St. James's Park, London. Brit. Birds, **50**: 2–10.—A study of breeding and postbreeding populations.

Guichard, G. 1959. Notes sur la biologie du Cisticole des Joncs *(Cisticola juncidis cisticola* Temm.). L'Oiseau, **29**: 88–95.—On the biology of the Fantailed Warbler in the Camargue.—E. E.

Hall, K. R. L. 1959. Nest records and additional behaviour notes for Kittlitz's Sandplover *Charadrius pecuarius* in s.w. Cape Province. Ostrich, **30**: 33–38.—Data for seven years show some egg laying throughout the year except the wet months of May and June; the peak months were December and January. Clutch size, position of eggs in the scrape, incubation periods, egg-covering reaction, and distraction displays are discussed.—E. E.

Haverschmidt, F. 1959. Notes on the nesting of *Turdus leucomelas* in Surinam. Wilson Bull., **71**: 175–177.

Hindwood, K. A. 1959. The nesting of birds in the nests of social insects. Emu, **59**: 1–36.—A compilation of birds known to nest in nests of termites, ants, and wasps. Nesting in termitaria occurs in many parrots, trogons, kingfishers, puffbirds, but has been reported also of hole-nesting species of other groups. Not mentioned, but a regular termitarium nester is the Orange-chinned Parakeet, *Brotogeris jugularis* of tropical America.—E. E.

Jakobs, B. 1959. Zum Brutvorkommen und zur Brutbiologie der Zippammer (*Emberiza cia cia* L.) im Moseltal. Orn. Mitteil., **11**: 121–125.—Breeding biology of the Rock Bunting.

Kuroda, N. 1959. A comparative study of the breeding biology of rural and urban colonies of the Gray Starling, *Sturnus cineraceus* Temminck. Japan Wildlife Bull., **17**: 31–77.—A thorough comparative study of two breeding colonies of this starling, one in Tokyo (one season, 18 occupied nest-boxes) and one in an agricultural area just outside Tokyo (two seasons, 17 and 20 occupied boxes). In addition to clearly presented numerical data on many aspects of breeding biology, there are interesting discussions of correlation of available food

supply with stage of nesting cycle, and of the phenomena affecting clutch size in this species. The rural colony fed over a wider area, but primarily on a single diet item (mole-crickets). The urban colony was restricted to small city parks for foraging, but obtained a wider variety of animal and plant food. Further investigations on food preferences are planned. (In English, with Japanese summary.)—K. C. P.

LACK, D. 1957. Notes on nesting Nightjars. Brit. Birds, **50**: 273–277.

MENG, H. 1959. Food habits of nesting Cooper's Hawks and Goshawks in New York and Pennsylvania. Wilson Bull., **71**: 169–174.—Prey brought to the nests were identified and counted. For *Accipiter cooperii* the commonest items were Starlings, Flickers, Meadowlarks, and Chipmunks. For *A. gentilis* they were Crows and Red Squirrels.—J. T. T.

OWEN, D. F. and G. C. PHILLIPS. 1956. The food of nestling Purple Herons [*Ardea purpurea*] in Holland. Brit. Birds, **49**: 494–499.

PICKERING, C. H. C. 1959. Notes sur le Puffin Cendre *(Puffinus diomedea borealis)* aux Iles Salvages. L'Oiseau, **29**: 1–3.—Notes on the nesting of Cory's Shearwater on the Salvages. Some 20,000 are killed for food annually.—E. E.

STEIN, F. 1959. Beitrag zur Biologie des Flussregenpfeifers, *Charadrius dubius curonicus* Gm. Beitr. z. Vogelkunde, **6**: 321–338.—This completes the account of the biology of the Little Ringed Plover, begun in Beitr. z. Vogelk, **6**: 311–320, 1958.

WACKERNAGEL, H. 1959. Ein Bruterfolg beim Chilenischer Flamingo in Zoologischen Garten Basel. Orn. Beob., **56**: 33–40.—At the Basel Zoo, in a mixed "colony" of flamingos, a pair of Chilean Flamingos successfully bred in June 1958. The incubation period was 29 days. At five days the nestling left the nest briefly, at 11 days it entered the water, at 12 weeks it could fly and had acquired full juvenal plumage, but the parents fed it until January when it was six months old.—E. E.

WALTERS, J. 1959. Regenpfeifer-Notizen aus dem "Seewinkel" im Burgenland (Oesterreich). Vogelwelt, **80**: 33–42.—Studies in the nesting and development of the Little Ring Plover and Kentish (Snowy) Plover *(Charadrius dubius* and *C. alexandrinus)* in Austria, with comparison of behavior in the Netherlands. —E. E.

WARNCKE, K. 1959. Eigenartiges Brutverhalten beim Mäusebussard [*Buteo buteo*]. Vogelwelt, **80**: 93.—Single egg clutches in the Common Buzzard. Among 33 normal clutches were five with single eggs; of these two proved infertile, two hatched, and one nest was not subsequently observed. As has been suggested for the Peregrine Falcon, and the Red Kite, single egg clutches are more likely to be infertile and perhaps indicate old age.—E. E.

MIGRATION AND ORIENTATION

ALLEN, R. H. and G. RUTTER. 1957. The moult migration of the Shelduck from Cheshire in 1956. Brit. Birds, **50**: 344–346.

ARNOULD, M., ET AL. 1959. Baguages, controles et reprises d'oiseaux migrateurs en Tunisie. Mém. Soc. Sci. Nat. Tunisie, no. **4**: 1–105, maps.—Banding data from Tunisia, with articles discussing aspects of migration.—E. E.

ASH, J. S., M. W. RIDLEY, and N. RIDLEY. 1956. On the movements and survival of woodpigeons and stock doves. Brit. Birds, **49**: 298–305.

CORNWALLIS, R. K. 1957. The pattern of migration in 1955 at the East Coast Bird Observatories. Brit. Birds, **50**: 105–118.

GAUSS, G. H. 1959. Ueber das Zugverhalten der Tannenmeise *(Parus ater)*. Vogelwelt, **80**: 83–89.—The Coal Tit, which favors coniferous woods, in autumn in Germany migrates directly southwest through forest, but will modify its direction to avoid open country, preferring to follow tree-bordered roads and streams, or even flying to isolated trees. The birds show hesitation to cross roads. When forced to traverse open areas without trees the southwestern direction is resumed.—E. E.

GOODBODY, I. M. 1956. Autumn migration on the Kintyre Peninsula. Brit. Birds, **49**: 417–431.

HARPER, W. G. 1959. The study of bird migration movements by radar. New Scientist, **5**: 791–793.—Study in Britain of mysterious radar echoes, called "angels," indicates that they represent flocks of moving birds. Nocturnal migration movement greatly exceeds daytime migration, reaching a maximum just before midnight. The heaviest migration occurs with clear skies. The most common height of migration is between 2,000–3,000 feet.—E. E.

LACK, D. 1957. The Chaffinch migration in North Devon. Brit. Birds, **50**: 10–19.

MARSHALL, A. J. and M. C. WILLIAMS. 1959. The pre-nuptial migration of the Yellow Wagtail *(Motacilla flava)* from latitude 0.04'N. Proc. Zool. Soc. Lond., **132**: 313–320.—Two European races of *M. flava* winter near Victoria Nyanza, Uganda, Africa, straddling the Equator, in an area where temperature and humidity changes are negligible. Specimens taken at Entebbe between October and April indicate that molt to a bright plumage occurs while gonads are still inactive, and that gonadal recrudescence and fat deposition are governed by an endogenous rhythm and not by any external climatic or light change occurring in the tropics. Birds may be kept in phase by conditions on the breeding grounds affecting the timing of reproductive activities in the breeding period preceding the southward migration.—E. E.

MONK, J. F. 1958. Notes on the ornithology of southwest Portugal. Anais Faculd. Ciên. do Porto, **40**: 7–24. Inst. Zool, Porto, Portugal.—Observations during migration September 12–October 2, 1956. (In English.)

NISBET, I. C. T. and J. BAIRD. 1959. The autumn migration of the Double-crested Cormorant through eastern New England. Mass. Aud. Bull., **43**: 224–227, map.—Most *Phalacrocorax auritus* breeding on the Atlantic coast are believed to cross the base of Cape Ann and Boston Bay, Massachusetts, then to cut *overland* in a southwesterly direction to southeastern Rhode Island, thence to Block Island, and Montauk Point on Long Island, New York. Relatively few birds follow the Massachusetts coast.—E. E.

PEAKALL, D. B. 1956. Migration at the Smith's Knoll Light-vessel, Autumn 1953. Brit. Birds, **49**: 373–388.—Observations made from mid-September to mid-November from a vessel situated 26 miles from the Norfolk coast and 90 miles from Holland. The study supports the theory that the main departure of Passerines from the Continent occurs at dawn.—F. M.

PROVINCE OF QUEBEC SOCIETY FOR THE PROTECTION OF BIRDS. 1958. Report on birds. Annual Rept. 1957: 12–35. Montreal.—The tabular migration summary, showing when each species was first and last noted in spring and fall and the height of migration in each season, is lucid and useful. It should be noted that this summary refers only to the Montreal area, not to the entire province;

confusion might have been avoided by so indicating in the title or at the start of the article. Near Quebec city a Western Meadowlark male reported to be mated to an Eastern Meadowlark female, with three young reared. A Green-tailed Towhee taken October 31, 1957 at St. Augustin, first for Quebec province. —E. E.

SCHIERBAUM, D., ET AL. 1959. Waterfowl banding in New York. N.Y. Fish and Game Jour., **6**: 86–102.—Methods of capture and migration routes. A map shows localities of recovery.—E. E.

SUMMERS-SMITH, D. 1956. Movements of House Sparrows. Brit. Birds, **49**: 465–488.—Reviews the subjects of movements and migration, extension of range, subspecies and regional variations in *Passer domesticus*.—F. M.

SVÄRDSON, G. 1957. The "invasion" type of bird migration. Brit. Birds, **50**: 314–343.—Ordinary migration is an adaptation to a seasonal food shortage while invasion is an adaptation to annual food fluctuations. Scandinavian literature on invasions of Siskins, Waxwings, Redpolls, Crossbills, and Fieldfares is reviewed. "It is suggested that invasions start annually, like ordinary migration, and that they are released by the same proximate factors. The movement is halted, however, early in some years, while it proceeds in others, the reason being that a rich food supply brings the flight to a stop."—F. M.

ULFSTRAND, S. 1959. [The bird migration at Falsterbo (Scania, SW Sweden) in 1955. (Report from Falsterbo Bird Station No. 14.)] Vår Fågelvärld, **18**: 131–162.—For various Falconiformes there are graphs showing numbers migrating in a given period, comparing 1955 with the average for previous years. (In Swedish; good summary and legends to figs. in English.)—E. E.

VERWEY, J. 1959. Orientation in migrating marine animals and a comparison with that of other migrants. Arch. Néerlandaises Zool., **13**, Suppl. 1: 418–446. —A useful review (including bird data) in English.—E. E.

PHYSIOLOGY

BOAS, N. F. 1958. The effect of desoxycorticosterone acetate on testis size and function in the cockerel. Endocrin., **63**: 323–328.

BOWMAN, J. C. and J. D. H. ARCHIBALD. 1959. Effect of controlled lighting on production characters in the fowl. Nature, **183**: 1138–1139.—Restricted lighting during rearing and increased lighting during laying increased egg production. —H. C. S.

FOX, S. and T. R. MORRIS. 1958. Flash lighting for egg production. Nature, **182**: 1752–1753.

FRANTZ, W. L. 1958. Some factors affecting spermatokinesis in the testes of the house sparrow *(Passer domesticus)*. Endocrin., **63**: 507–516.—Evidence that water absorption causes rupture of Sertoli cells and subsequent release of sperm. —H. C. S.

HAZELWOOD, R. L. 1958. The peripheral action of tolbutamide in domestic fowl. Endocrin., **63**: 611–618.

KOBAYASHI, H. 1958. On the induction of molt in birds by 17 α-oxyprogesterone-17-capronate. Endocrin., **63**: 420–430.—Of 19 species of birds tested, three *(Melopsittacus, Uroloncha, Coturnix)* molted after injection, 16 did not respond. The first group breed all year round, the second has a restricted breeding season. —H. C. S.

KOWALEWSKI, K. 1958. Uptake of radiosulfate in growing bones of cockerels treated with cortisone and certain anabolic-androgenic steroids. Endocrin., **63**: 759–764.

LYTLE, I. M. and F. W. LORENZ. 1958. Progesterone in the blood of the laying hen. Nature, **182**: 1681.

MATTHEWS, L. N. 1959. Salt excretion in marine birds. Nature, **183**: 202.—Visible drops of water on nose of giant petrel.—H. C. S.

MEYER, R. K., M. APPASWAMY RAO, and R. L. ASPINALL. 1959. Inhibition of the development of the bursa of Fabricius in the embryos of the common fowl by 19-nortestosterone. Endocrin., **64**: 890–897.

MILLER, A. H. 1959. Reproductive cycles in an equatorial sparrow. Proc. Nat. Acad. Sci., **45**: 1095–1100.—In individual males of *Zonotrichia capensis*, studied in southern Colombia, the maxima and minima of the reproductive period cover six months so that there are two complete cycles in the calendar year.

MIRSKY, I. A. and S. GITELSON. 1958. The diabetic response of geese to pancreatectomy. Endocrin., **63**: 345–348.

MIRSKY, I. A., G. PERISUTTI, and N. C. DAVIS. 1959. The destruction of glucagon by the blood plasma from various species. Endocrin., **64**: 992–1001.—Includes chicken.

MORRIS, T. R. and S. FOX. 1958. Artificial light and sexual maturity in the fowl. Nature, **182**: 1522–1523.—Further evidence that sexual maturity is affected by changes in day length and not by absolute day length.—H. C. S.

NEWCOMER, W. S. 1959. Effects of hypophysectomy on some functional aspects of the adrenal gland of the chicken. Endocrin., **65**: 133–135.—Results imply functional independence of adrenal cortical tissue and anterior pituitary in chicken.—H. C. S.

POLIN, D. and P. D. STURKIE. 1958. Parathyroid and gonad relationship in regulating blood calcium fractions in chickens. Endocrin., **63**: 177–182.

ROSE, G. G., and J. B. TRUNNELL. 1959. Thyroid epithelium in tissue cultures: observations on the morphology and functional capacities of embryo chick thyroids. Endocrin., **64**: 344–354.

ROY, R. N. and B. C. GUHA. 1958. Production of experimental scurvy in a bird species. Nature, **182**: 1689–1690.—The red-vented bulbul *(Pycnonotus cafer)* is incapable of synthesizing ascorbic acid.—H. C. S.

RUSSELL, F. S. 1958. Salt excretion in marine birds. Nature, **182**: 1755.—Drops of water observed on beaks of Lesser Black-backed Gulls.—H. C. S.

SMOCZKIEWICZOWA, A. 1959. Sodium, potassium, calcium and chloride ion contents and protein fractions in the fluids of chick embryos. Nature, **183**: 1260–1261.

TABER, E., M. CLAYTOR, J. KNIGHT, J. FLOWERS, D. GAMBRELL, and C. AYERS. 1958. Some effects of sex hormones and homologous gonadotrophins on the early development of the rudimentary gonad in fowl. Endocrin., **63**: 435–448.

URIST, M. R., O. A. SCHJEIDE, and F. C. MCLEAN. 1958. The partition and binding of calcium in the serum of the laying hen and of the estrogenized rooster. Endocrin., **63**: 570–585.

TAXONOMY AND PALAEONTOLOGY

AMADON, D. 1959. The subspecies of *Tinamus tao* and *Tinamus solitarius* (Aves). Amer. Mus. Novitates, 1955: 7 pp.—Admitted are *T. t. septentrionalis, larensis,*

***kleei*, and *tao*; and *T. s. pernambucensis* and *solitarius*.** These large tinamous are known from relatively few specimens; series of the recognized races available to the author ranged from 0 to 12 skins.—K. C. P.

Brodkorb, P. 1959. The Pleistocene avifauna of Arredondo, Florida. Bull. Florida State Mus., **4**: 269–291.—Identified are 43 species; described as new: *Falco readei, Colinus suilium, Dorypaltus prosphatus* (Charadriidae, n. gen.) *Cremaster tytthus* (Icteridae, n. gen.), all from the Illinoian glacial stage, and believed to be interglacial relicts.—E. E.

Brodkorb, P. 1959. Pleistocene birds from New Providence Island, Bahamas. Bull. Florida State Mus., **4**: 349–371.—The deposit is believed to relate to part of the Wisconsin glacial stage when the land area of the Bahamas was much greater and closely approached Cuba. Of 15 birds identified, only four still occur on the island; the others are today more southern or are known only as fossils. Described as new: *Caracara creightoni, Burhinus nanus, Claucidium dickinsoni, Otus providentiae, Bathoceleus hyphalus* (Picidae, n. gen.), *Corcus wetmorei*. The author points out that the gender of *Caracara* is feminine.—E. E.

Clancey, P. A. 1959. Miscellaneous taxonomic notes on African birds. XII. Durban Mus. Novit, **5**: 151–179.—*Subsp. nov.: Apaloderma narina arcanum*, southern Sudan; *Malaconotus sulfureopectus terminus*, eastern Cape Province; *Ploceus velatus inustus*, western Cape Province. Also discusses *Ploceus intermedius*.—E. E.

Galbreath, E. C. 1959. Collecting fossils from Harvester Ant Mounds. Trans. Kansas Acad. Sci., **62**: no. 2, Summer, 173–174.

Koepcke, M. 1959. Ein neuer *Asthenes* (Aves, Furnariidae) von der Küste und dem westlichen Andenabhang Südperus. Beitr. z. neotrop. Fauna, **1**, no. 3: 243–248.—A new species of spinetail, *Asthenes cactorum*, described from the cactus desert, western slope Andes of southern Peru, collected between Atico and Arequipa. Attractive drawings of the bird and its nest and habitat.—E. E.

Levine, N. D. "1958." [= 1959]. Uniform endings for the names of higher taxa. Syst. Zool., **7**: 134–135.—Still another attempt. Under the author's suggested system the Mallard would belong to the class Aveasida, subclass Neornithasina, superorder Neognathorica, order Anserorida, suborder Anserorina, family Anatidae, subfamily Anatinae, and tribe Anatibida.—K. C. P.

Mainardi, D. 1958. Immunology and chromatography in taxonomic studies on gallinaceous birds. Nature, **182**: 1388–1389.—Numida and Meleagris have closer immunological affinities than either to Gallus.—H. C. S.

Parkes, K. C. 1958. Systematic notes on North American birds. 2. The waterfowl (Anatidae). Ann. Carnegie Mus., **35**: 117–125.—Does not fully agree with either the lumping of Delacour or the conservatism of the new A.O.U. Check-list in their taxonomic treatments. Agrees that the shovelers may be a polyphyletic group.—E. E.

Ripley, S. D. 1958. A note on the Firethroat and the Blackthroated Robin. Postilla, no. **37**: 1–3.—Considers *Luscinia obscura* of northwest China a distinct species and not a color phase of *L. pectardens*.—E. E.

Ripley, S. D. 1959. Comments on birds from the western Papuan Islands. Postilla, no. **38**: 1–17.—Chiefly a list with taxonomic comments of birds taken on Kofiau Island. Described as new: *Monarcha julianae* (in *M. leucurus* superspecies), *Nectarinia sericea mariae*.—E. E.

SIBLEY, C. G. 1958. Hybridization in some Colombian tanagers, avian genus *Ramphocelus*. Proc. Amer. Phil. Soc., **102**, no. 5: 448–453.—A color cline exists between the scarlet-rumped *R. flammigerus* of the Cauca Valley and the yellow-rumped *R. icteronotus* of the Pacific coast. Orange-rumped birds, *"R. chrysonotus,"* are believed to have resulted from hybridization, following the cutting of heavy forest formerly separating these populations. It is proposed that the two forms be treated as conspecific, *sub nom. R. flammigerus*. *R. passerinii* Bonaparte 1831, of Middle America, may prove to be as closely related to *icteronotus;* it bears an earlier name. There is a discussion of analogous cases of hybridization, some, like *Collaptes,* involving similar carotenoid pigments.—E. E.

SIMS, R. W. 1959. The *Ceyx erithacus* and *rufidorsus* species problem. Jour. Linnaean Soc. London, Zoology, **44**: 215–221.—In view of the intermediacy of characters in areas where these strikingly different kingfishers overlap, lack of reproductive isolation is indicated, and it is proposed to treat them as one species, *C. erithacus*.—E. E.

SMITH, H. M. "1958" [= 1959]. The synthetic natural populational species in biology. Syst. Zool., **7**: 116–119.—An attempt to reconcile three fundamentally different species concepts ("Mendelian," "clonal," and "phyletic"), using the terminology usually applied to the first of these.—K. C. P.

STARRETT, A. "1958" [= 1959]. What *is* the subspecies problem? Syst. Zool., **7**: 111–115.—Viewpoints expressed in papers in Systematic Zoology on specific and infraspecific taxonomy are reviewed. The relative importance of the *concept* vs. the *category* of "subspecies" depends on the aims of the system of classification, and is affected by the stage of knowledge of the group of animals being studied. Unwise use of the subspecies by some authors is irrelevant to the evaluation of infraspecific systematics, as such authors would probably abuse any alternative system of classification.—K. C. P.

STORER, R. W. and D. A. ZIMMERMAN. 1959. Variation in the Blue Grosbeak *(Guiraca caerulea)* with special reference to the Mexican populations. Occ. Pap. Mus. Zool. Univ. Mich., **609**: 1–13.—*G. c. chiapensis* Nelson considered a valid race.

VAURIE, C. 1959. Systematic notes on Palearctic birds. No. 33. Passeriformes. Amer. Mus. Nat. Hist.: 15 pp.—An analytical index to the author's series of papers in the Amer. Mus. Novitates, 1953–1958. In addition to usual indices (chronological list, illustrations, new forms, and alphabetic index to names), Vaurie has indexed his papers according to the nature of the taxonomic or biological problems discussed.—K. C. P.

VAURIE, C. 1959. Systematic notes on Palearctic birds. No. 34. Picidae: The genera *Picus* and *Dryocopus*.—With the publication of the passerine volume of his Palearctic list, Vaurie now commences work on the nonpasserines. The races of the Green Woodpecker *(P. viridis)* are reduced to four, one of which (*vaillantii* of North Africa) has usually been considered a separate species. Nine Palearctic (plus four extralimital, not examined) races are admitted of the Gray-headed Woodpecker *(P. canus)*, and two of the Great Black Woodpecker *(D. martius)*.—K. C. P.

VAURIE, C. 1959. Systematic notes on Palearctic birds. No. 35. Picidae: The genus *Dendrocopos* (Part 1).—Species discussed, with the number of races admitted (a reduction from previous authors in all cases), are *D. major* (22), *leucopterus* (0), *syriacus* (0), *assimilis* (0), *darjellensis* (2), *cathpharius* (6),

medius (3), and *leucotos* (12). *D. major tianshanicus* is tentatively identified as a hybrid population, *D. major* x *D. leucopterus*. Hybridization between *D. syriacus* and *D. assimilis* is also discussed. Described as new is *D. cathpharius ludlowi* (Tsera, Pome, southwestern Sikang).—K. C. P.

WETMORE, A. 1959. Notes on certain grouse of the Pleistocene. Wilson Bull., **71**: 178–182.—*Tympanuchus, Pedioecetes,* and *Bonasa* from sites in Arkansas and Pennsylvania.—J. T. T.

WINTERBOTTOM, J. M. 1959. A review of the subspecies of the Yellow Canary *Serinus flaviventris* (Swainson). Ann. South African Mus., **44**: 315–321.—*Subsp. nov.: S. f. quintoni* from Hillmore, Beaufort West, in the Karoo areas of South Africa.—E. E.

WOOLFENDEN, G. E. 1959. A Pleistocene avifauna from Rock Spring, Florida. Wilson Bull., **71**: 183–187.—Thirty-five species and one additional genus were identified from a deposit probably formed in a fresh water habitat. Only two of the species are extinct.—J. T. T.

NOTES AND NEWS

The Secretary of the Union has been authorized by the Council to prepare an up-to-date membership list during 1960. Members of all classes are urged to bring to his attention errors in the latest list (October 1957), such as omissions of names, misspellings, erroneous alphabetization, incorrect class letters preceding names, wrong addresses, etc. Without such cooperation from those most concerned, a list relatively free of mistakes cannot be produced.

Mrs. Marjorie Ledingham, Secretary of the Local Committee on Arrangements for the Regina meeting, brings to the attention of the membership that copies of the group photograph may still be obtained from Stan's Photography, 3420 Hill Avenue, Regina, Saskatchewan, at a cost of $1.25 (*including* twenty-five cents for mailing).

She points out also that any registered member or guest who failed to receive a free "Avocet Calendar" at the banquet may acquire one by writing to Mr. Elmer Fox, 1053 Gladmer Park, Regina.

Through the generosity of the Marcia Brady Tucker Foundation, Inc., we are again in a position to award funds to assist promising young ornithologists to attend the annual meeting of the Union. The amount granted will depend upon distance to be travelled and personal need. Any member may nominate candidates. It is not required that awardees present papers at the meeting, but since some may wish to apply for a position on the program, it is important that nominations be in hand *not later than* 1 June 1960.

Please send to the Secretary (H. G. Deignan, U.S. National Museum, Washington 25, D.C.) the following information: (1) name, age, and address of the nominee; (2) education and experience of the nominee; (3) a statement by the sponsor on the capabilities, special interest, and financial need of the nominee.

The A.O.U. Council at the 1959 meetings in Regina authorized issuance of the first grants for research from the income of the Josselyn Van Tyne Memorial Fund. A sum of approximately $600 will become available at the end of the fiscal year, 31 July 1960. The Council assigned to the Research Committee the administering of these grants, and it is hoped that the first recipient or recipients may be announced at the next A.O.U. meeting in Ann Arbor in August.

Any student of birds who has a special need for equipment, travel, assistance, or materials to further his research is invited to submit an application (10 duplicate copies) for a portion or all of the money available. This application should give a full description of the proposed research, the type of help that is required, when the money should be made available, the background and training of the applicant, and other pertinent information. The applications will be evaluated and rated by the Research Committee to determine how the funds will be allotted.

All applications for grants must be in the hands of the chairman not later than 1 June 1960.—S. C. Kendeigh, *Chairman, Vivarium Building, University of Illinois, Wright and Healey Streets, Champaign, Illinois.*

OBITUARIES

Our Corresponding Fellow, GUSTAV KRAMER, lost his life in Calabria on April 19, 1959, at the age of 49 years, while attempting to secure wild young Rock Doves from their nest on a cliff. An unusually brilliant research career thus came to a premature end. The loss to ornithological science is evident when we review Kramer's fundamental discoveries, among which sun orientation and the existence of an internal clock are best known. The role of allometry in phyletic evolution was another of his research interests, and again he revitalized the field by novel methods and findings. Whoever met Kramer was at once impressed by the enormous clarity of his thinking and by his ability to free himself from time-honored assumptions. He was revered by his friends for his complete integrity, reliability, and warm humor. Unselfish and sensitive, brilliant and modest, an intellectual and yet a romantic, he was an unforgettable personality. Ornithology has lost one of its leaders.

For a detailed biography (with bibliography) by E. Stresemann see Zeitschr. Tierpsych., 16: 257–266 (1959).—ERNST MAYR.

LOGAN JOHNSON BENNETT, an Elective Member of the American Ornithologists' Union, died suddenly on 12 September 1957, in Las Vegas, Nevada, at the age of 50, while attending the annual meeting of the International Association of Game, Fish and Conservation Commissioners. He was Executive Director of the Pennsylvania Game Commission, a position he had held since 1953. He was born in Festus, Missouri, on 29 August 1907, received his B.S. from Central College, Fayette, Missouri, in 1930, and his M.S. and Ph.D. from Iowa State in 1932 and 1937. His doctoral thesis, "The Blue-winged Teal, its ecology and management," published in 1938, is an authoritative treatise on the life history and ecological problems of the species in the prairie states.

Dr. Bennett joined the A.O.U. in 1934 and was elected an Elective Member in 1946. His positions in the wildlife management field before his Pennsylvania appointment included those of Game Technician, Iowa State Conservation Commission, 1934-1935; Leader, Iowa Cooperative Research Unit, Iowa State College, 1935-1938; Leader, Pennsylvania Cooperative Wildlife Research Unit, 1938-1943; senior biologist in charge of cooperative wildlife research program, U.S. Fish and Wildlife Service, 1947-1948; and Chief, Branch of Wildlife Research, 1948-1953. During the war years he served in the South Pacific as a naval lieutenant (senior grade) on malaria-control work.

He was a charter member and past president of the Wildlife Society and a member of numerous other professional societies. Game management was his profession, and outdoor life was his hobby, a combination which fitted him admirably for his position with the Pennsylvania Game Commission. He could see both the conservationist's and sportsman's side of a controversy with understanding, yet make a decision with the respect of both. His testimony before a Pennsylvania Senate committee on the impracticability of the previous hawk statute contributed greatly to the passage of the present law, which effectively stopped the slaughter along the ridges of the northeastern portion of the state.

He wrote a book, "The Training of Grouse and Woodcock Dogs," and contributed many papers in the field of wildlife management and on sporting dogs and hunting. He published twice in "The Auk," a short note (1937) on the first recorded breeding of the Canvasback in Iowa, and, as co-author, a paper (1939) on the adaptability of birds to changed environment.—PHILLIPS B. STREET.

PRINCE NOBUSUKE TAKA-TSUKASA, a Corresponding Fellow, was born on April 29, 1889, and died in Tokyo on February 1, 1959. The head of one of the oldest noble families of the Japanese Court, he was a lover of birds and nature, and he made a serious study of Natural History, particularly ornithology and aviculture, graduating at the Zoological Institute, Faculty of Science, Imperial University of Tokyo in 1914, obtaining a doctor's degree in 1943. He became president of the Ornithological Society of Japan in 1922 and held that position until 1946. He was a special member of the Hunting Committee of the Department of Agriculture and Forestry since 1923, and a member of the Study of Natural Sciences Committee since 1940.

Prince Taka-Tsukasa traveled widely through Europe and the United States in 1924 and 1925 to pursue his bird studies. I met him then in London and in Paris and we soon became close friends. He was a most kind host to me during my visits to Japan in 1926 and 1927, showing me many interesting native birds, and helping me in gathering collections.

He took an active part in the promotion of bird studies in his country, keeping himself large collections of both live birds and skins. Besides various papers in the ornithological magazines of Japan and of other different countries, he published the following books:

1917 Kaidori [Cage birds]; 1928, 6th ed., 700 pages, col. pls. and text-figs.

1930 Kaidori Shusei [Coloured Plates of Cage Birds in Japan]. 320 pp., 61 col. pls.

1932-38 The Birds of Nippon. Vol. I (In English).

1941 Japanese Birds (In English) 132 pp. 1 col. pl. (front), and many photos. Tourist Library: 35.

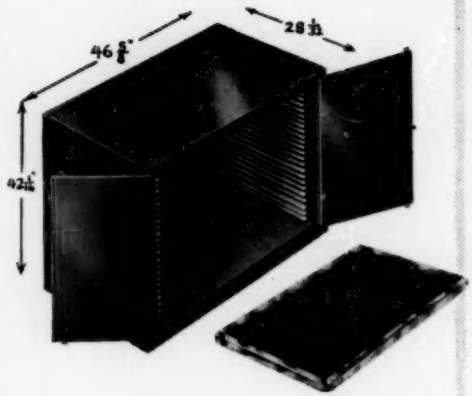
1944 Studies on the Galli of Nippon.

If it had been completed, his "Birds of Nippon" would have been a magnificent work. The only part published, Game Birds, is detailed, well conceived, and indeed excellent.

A cordial, genuine man, Prince Taka-Tsukasa was hard hit by the last war, losing his home and his collections. From his letters which reached me regularly through the years, one could realize that he never became bitter nor discouraged. As the High Priest of the Meiji Shrine, he lived his last years in a beautiful park where wild birds abound despite its location in Tokyo and he enjoyed them greatly.

A number of birds have been named after him and he described with Dr. Yamashina a very interesting new White-eye from Ponapé, *Cynnirorhyncha longirostra* (1931).

Prince Taka-Tsukasa, beside being a Corresponding Fellow of the American Ornithologists' Union, was a member of most of the ornithological societies of the world.—J. DELACOUR.



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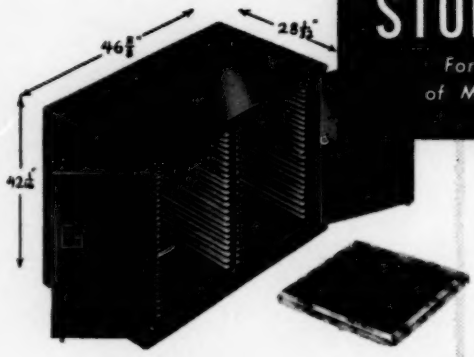

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